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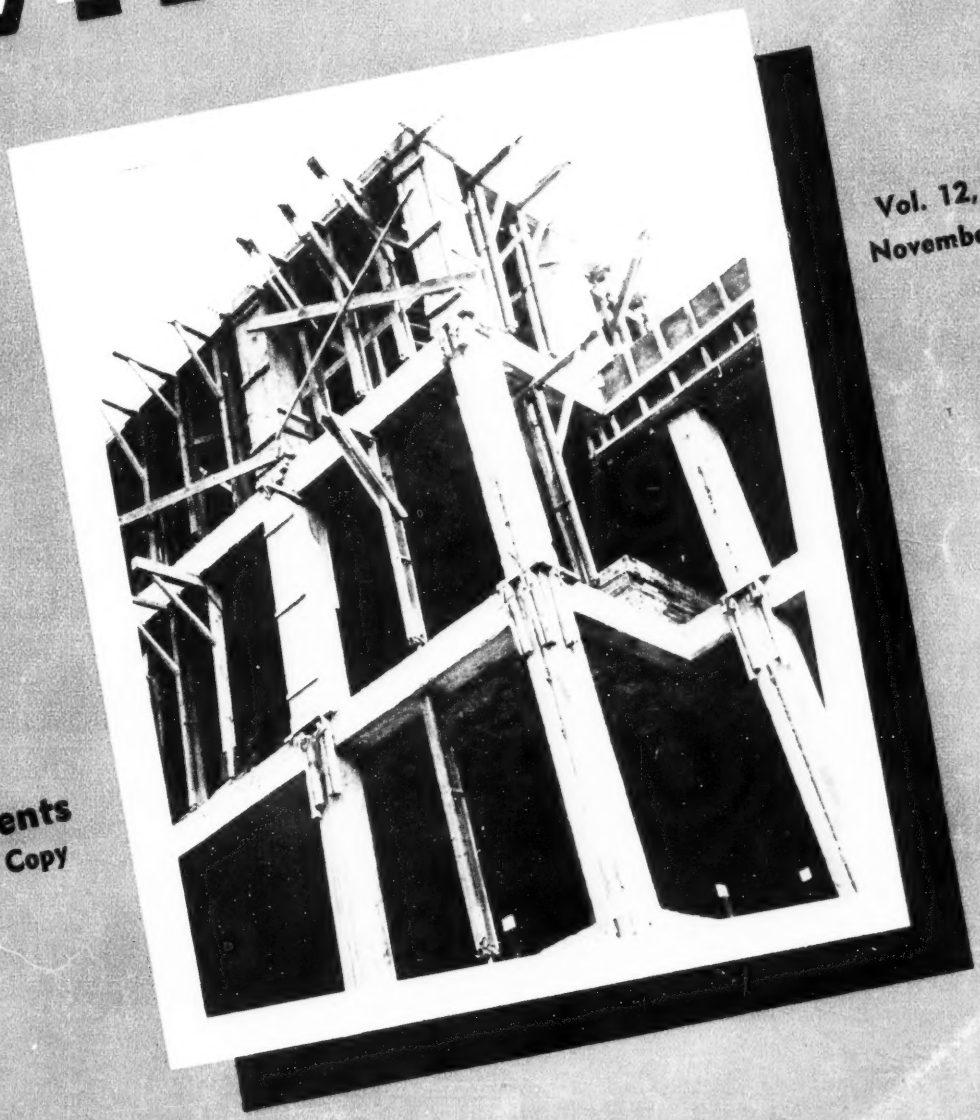
THE CORNELL ENGINEER



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November, 1946

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The CORNELL ENGINEER

Volume 12 Number 2

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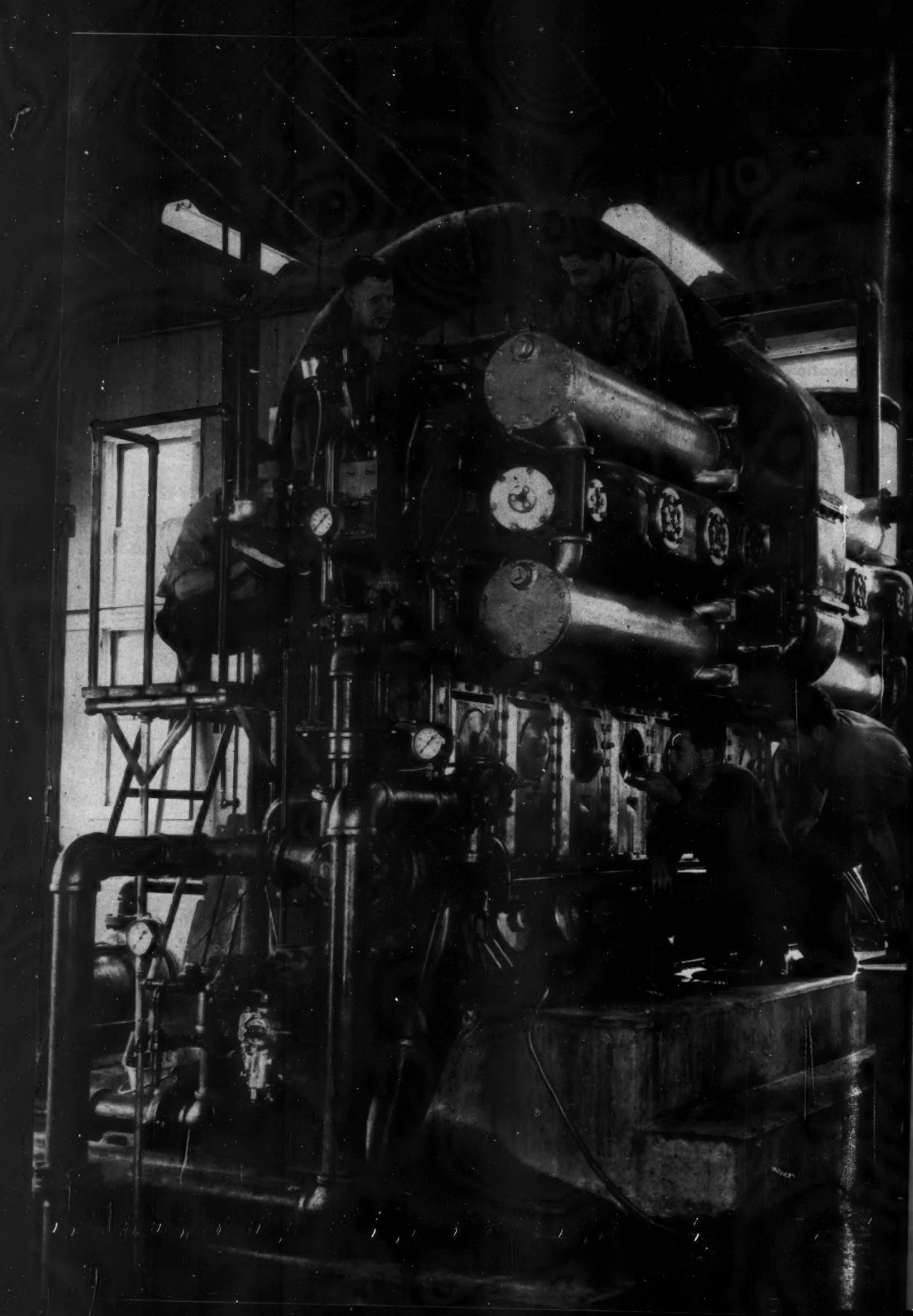

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Mechanical Engineering at Sibley

Engineering at Cornell (17)

By W. JULIAN KING

Director of the Sibley School of Mechanical Engineering

One of Sibley's major assets is its tradition of excellence and leadership in engineering instruction, commencing in the early days of the Industrial Revolution and sustained by an unbroken succession of outstanding teachers and engineers. From its beginning as the College of the Mechanic Arts, housed in Morrill Hall when the University opened its doors in 1868, it has pioneered in developing the scientific foundations of Mechanical Engineering and in contributing to the curricula, literature, and advanced methods of teaching. Throughout its history, many members of the faculty have contributed notable works to engineering literature, such as, Carpenter's *Experimental Engineering*, Kimball's *Principles of Industrial Engineering*, and Barnard, Ellenwood, and Hirshfield's 3-volume treatise on *Heat-Power Engineering*. Dr. Robert Henry Thurston, who became Director of Sibley College in 1885 and was the first president of the A. S. M. E., is regarded as the founder of the modern laboratory system of engineering education. He also contributed several classic volumes on the steam engine and was a prolific writer on other engineering subjects. Dr. Thurston was one of the distinguished scientists of his time, and his pioneering achievements as an engineer, scholar and teacher added greatly to Cornell's prestige.

The college was renamed The Sibley College of the Mechanic Arts in 1870, when it was moved into West Sibley, the first of the group donated by Hiram Sibley and his son. The Mechanical Laboratory buildings and the foundry and metal working shops were erected in the interval from 1883 to 1887. About this time, after Dr. Thurston had taken over, the name of the school was changed to The Sibley College of Mechanical Engineering and the Mechanic Arts.

Sibley Dome was built in 1902. Rand Hall, the last permanent building to be added to the Mechanical Engineering group, was completed in 1912.

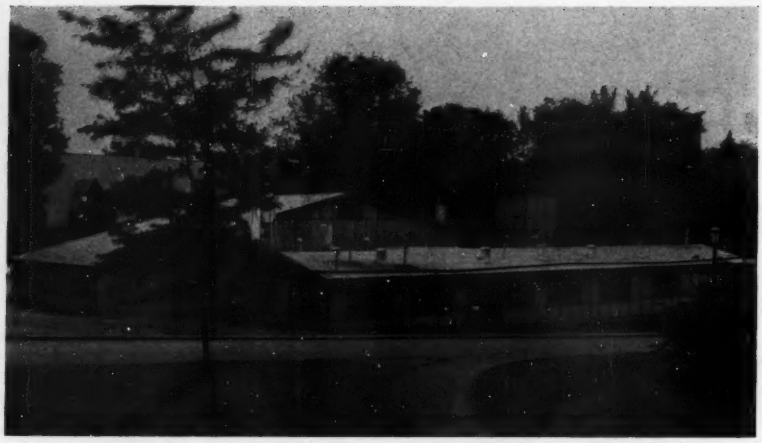
During Dr. Thurston's regime from 1885 until his untimely death in 1904, Sibley College grew from 150 to 1050 students, in spite of increasing entrance requirements which raised the standards to the highest in the country. Toward the end of this period, two pioneering gas turbine research projects were carried out in the Mechanical Laboratory, one by Walter O. Amsler and the other by Sanford A. Moss. Many years later, Dr. Moss's work culminated in the development of the General Electric turbosupercharger, used so effectively in military aircraft during World War II.

Dr. Thurston was succeeded by A. W. Smith, who was Dean of the College until his retirement in 1921. During this period, Professor A. E. Wells introduced the idea that college shop courses should illustrate manufacturing processes rather than develop manual skill, and Professor Dexter S. Kimball inaugurated his pioneer courses in Indus-

THE AUTHOR

William Julian King, authority on combustion and gas turbines with Battelle Memorial Institute, is the new director of the Sibley School of Mechanical Engineering. Hailing from Baton Rouge, La., he received the B.Ch.E. in 1925 and the M.E. in 1933 at Tulane University. He was associated with General Electric from 1926 until 1945 when he joined Battelle Institute in charge of combustion research. Author of many professional articles, Prof. King is best known for his "Unwritten Laws of Engineering," for which he received the Melville Award by the ASME. The articles broke all ASME records for the number of reprints requested. He holds four patents on heating and air-conditioning equipment, and has done much basic research on heat transfer.

Prof. King



The Diesel Laboratory will be utilized by the Sibley School for instruction and research in Diesel engine technology.

trail Organization and Administration.

Electrical Engineering was originally included in Sibley, beginning in 1882, as a special option in the senior year, administered by the Physics Department. It remained a part of Sibley until 1921 when the Colleges of Civil and Mechanical Engineering were merged into the single College of Engineering under Dean Kimball. The College then included the Sibley School of Mechanical Engineering under Director Diederichs, the School of Civil Engineering under Director Barnes, and the School of Electrical Engineering under Director Gray. Director Diederichs was an able administrator and teacher who built up a substantial reputation in the engineering world.

During the dynamic quarter century since 1921, the Sibley School has turned out thousands of the world's top-notch mechanical engineers and hundreds of professors and deans who have played a prominent part in developing other distinguished engineering colleges. Since 1936, when he succeeded Director Diederichs, Director W. N. Barnard has sustained the Sibley tradition of sound instruction in engineering fundamentals and has helped to inaugurate the new 5-year courses adopted by the entire College. He also piloted the School through the turbulent war years while the Navy V-12 courses were added to the curriculum. Professor Barnard retired to a well-earned rest on June 30, 1946 after serving on the Sibley faculty for forty-three years.

Organization

The Sibley School of Mechanical Engineering is made up of eight major departments, each headed by a professor, in addition to the director, assistant director, and secretary to the director, as indicated in the diagram below.

At the present time, the primary function of the Mechanical Engineering Laboratory is to provide laboratory instruction in the subjects taught by lecture and recitation in the Heat-Power Department. Consideration is being given to the advantages of combining these two departments into a single Heat-Power Department to provide closer coordination of laboratory and lecture courses.

Faculty

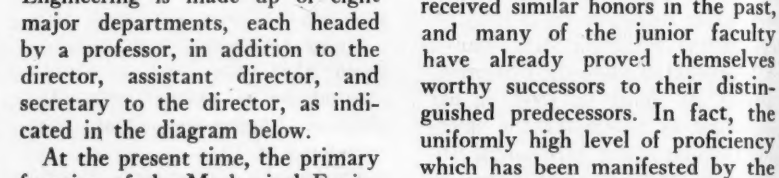
The Sibley Faculty consists of 15 professors, 16 associate professors, 12 assistant professors, 17 full-time and 10 part-time instructors. These are supported by 4 foremen, 10 mechanicians, a fireman, storekeeper, and 10 stenographers —making a total of 94 persons in the faculty and staff.

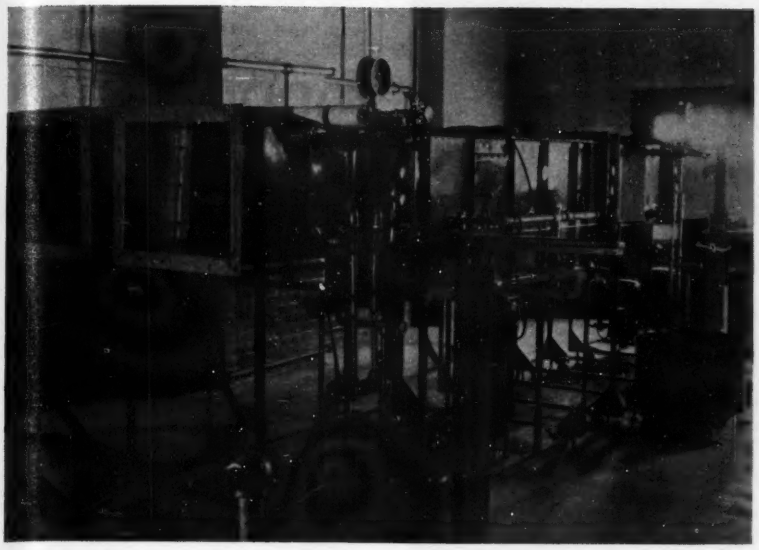
The senior members of the faculty are exceptionally well qualified in terms of academic and industrial experience, professional contacts, and activity in the major engineering societies. Indeed, this group constitutes the most important asset of the Sibley School. One of its number, Dr. James Norman Goodier, was the first recipient of the George Westinghouse Award in Engineering Education, "An Anual Award of $1000 for Distinguished Contributions to the Teaching of Engineering Students," presented to him by the Society for the Promotion of Engineering Education at its annual meeting in June of this year. Several others have received similar honors in the past, and many of the junior faculty have already proved themselves worthy successors to their distinguished predecessors. In fact, the uniformly high level of proficiency which has been manifested by the staff in all categories has been largely responsible for the prestige of the School in the past and augurs well for its future.

Objectives

The basic objectives of the Sibley School may be stated as follows: first, to turn out recognizably superior mechanical engineers, with the accent on quality rather than quantity; second, to develop special competence for engineering leadership, in administrative, as well as in technical fields; third, to equip its graduates to lead more interesting and useful lives as members of society; and finally, to trans-

Diagram of Sibley School organization





New equipment for air conditioning test facilities installed in West Mechanical Laboratory.

mit to all students a high regard for the paramount importance of Character and Integrity, without which no accomplishment in any of these fields can be truly worth while. Along with these aims, it is a further objective of the School to contribute as effectively as possible to the advancement of the science and profession of mechanical engineering, in line with the interests of industry and of the nation.

Curricula

The College of Engineering has returned to the normal, two-semester academic year. Beginning with the fall term of this year, all recent graduates from secondary schools entering Sibley as freshmen will be required to undertake the new five-year curriculum in Mechanical Engineering, leading to the B.M.E. degree. The new curriculum is arranged to provide stronger training in the technical fundamentals, additional courses in industrial management and leadership, and broader instruction in the cultural and "humanistic" subjects. A more detailed description of the new program will be found in the April 1946 (Vol. 11, No. 7) issue of the CORNELL ENGINEER. The inauguration of this program marks a most significant step forward in the furtherance of the objectives of the School, as set forth above.

Meanwhile, returning Cornell undergraduates, who have completed by July 1, 1946 one or more terms of the four-year curricula, may, if they so desire, follow either the four-year curriculum in Mechanical Engineering or that in Administrative Engineering, as given in recent years. New students with military records prior to July 1, 1946, may choose either the four-year or the five year curriculum. The four-year curriculum, which will cover substantially the content now included in the present curriculum leading to the B.M.E. degree, will lead to the degree of B.S. in M.E.

The actual content of the four and five-year curricula is subject to continual review and revision to keep it up-to-the-minute relative to such new developments as jet propulsion and the mechanical engineering aspects of atomic power. Plans are now in the making for giving special attention to the newer trends in instrumentation and control, automatic machine tools, hydraulic power transmission, servomechanisms, industrial administration, "human engineering," gas turbines, Diesel engines, and combustion equipment. (See No. 14 of this series in the CORNELL ENGINEER Vol. 11, No. 8 for a description of Professor Loberg's course in Industrial and Engineering Administration.) The primary emphasis will, as always, be placed upon such fundamentals as thermodynamics, fluid mechanics, and kinematics, along with the basic courses in mathematics, physics, chemistry, and English.

Postgraduate study, under the aegis of the Graduate School, will be encouraged and supported by Sibley to the fullest practicable extent. In addition to the benefits derived by the students, graduate work benefits the School by affording a source for the junior faculty, providing manpower for research, stimulating the faculty, and promoting contacts with industry. Industry is also benefited by the opportunities for advanced training offered to qualified employees, and by the special contributions in specific fields which some students are enabled to bring with them into industry.

At present, the Sibley School is considering the possibility of providing formal cooperative courses involving regularly scheduled per-

(Continued on page 24)

Over-all view of Materials Processing Lab in Rand Hall.

METALLURGY OF COPPER

By KEITH G. BLANTON, ChemE '48

All photos courtesy Anaconda Copper Mining Co.

In the ancient world copper was first found on the island of Cyprus off the coast of Greece. This new metal was first known as Cyprian metal after the island on which it was found. Through changes from cyprian metal to cyprum, cuprum and finally to copper, we get the name that is used today.

Copper was used by primitive man to make weapons and tools. It was found by these primitive men that when tin was alloyed with copper it was much harder. This alloy has become known by the name of bronze.

When the copper ore lies near the surface, overlying soil and rock are removed and the ore is shoveled out with electric shovels. This is known as open-pit mining and is very easy and economical. However in most cases the ore is mined underground. Shafts go down over a mile into the earth. The ore is drilled and blasted out of the rocky walls of the tunnel and hauled to the surface in dump buckets at great speed. The richer ores are harder to mine because the metal is difficult to tear apart. Native copper actually binds the rocks together. Copper is mined in nearly every country in Europe, in Siberia, Japan, Chile, Mexico, Canada, Australia, and Africa. However, about one third of the worlds total smelter output of copper is produced in the United States. The states that lead in the production of copper in increasing importance are Arizona, Utah, Montana, Nevada, and Michigan.

Copper Ores

Copper is found in nature in several ores of very beautiful colors. The most important copper ores other than native copper are chalcopyrite and chalcacite. Five other ores of lesser importance but still relatively important are malachite, azurite, bornite, cuprite, and chrysocolla.

Chalcocite, sometimes called copperglance, is a compound of copper and sulfur containing eighty per cent copper. It is the most important copper ore. Large quantities of this particular ore are found near Butte, Montana. Chalcocite has a metallic luster and a dark lead gray color often with a blue or green tarnish. It usually occurs in huge lumps.

Chalcopyrite, more commonly known as copper pyrite, is another very important copper ore. It contains the elements sulfur, iron, and thrity-five per cent copper. This ore is of a golden yellow brassy color. It has a metallic luster and an irridescent tarnish. It can be scratched easily with a knife.

Bornite, although it contains fifty-five per cent copper (more than chalcopyrite), is less important than chalcopyrite because it is much less common. It has a purple tarnish and a coal-like luster.

Miner on the 3800 foot level of a copper mine breaking up the gangue in preparation for setting an explosive charge.

Malachite is formed in nature by the action of water and carbon dioxide on the copper of copper ores. It is greenish in color and is usually granular or earthy. It may appear as a crust on other rocky material. This ore containing fifty-five percent copper is found in Arizona and Tennessee.

Azurite is the only common mineral that is blue in color. It is found with malachite and also contains about fifty-five percent copper.

Cuprite, or ruby copper, is the only copper ore of a red color besides native copper itself. It is found in the upper levels of copper mines. Its surface turns black when exposed to air.

Chrysocolla is sky blue or greenish blue in color. It is not a very common ore.

Smelting

With native copper, which is found along the shores of Lake Superior in Michigan, the smelting processes aren't difficult. The metal is first concentrated by crushing, grinding, and washing the ore. The remaining gangue, rocky or earthy matter, is then removed by heating the concentrate in a furnace in the presence of a suitable flux, usually limestone. The copper melts and collects beneath the silicate slag that is formed by the reaction between the flux and the gangue. The melted metal is poured from the furnace and cast into ingots.

The oxide ores when rich in copper were formerly smelted with coke, or charcoal, and a suitable flux in blast furnaces similar to those employed in the iron industry except that the sides are jacket-

ed with running water to keep them cool. This practice is still continued in some localities for screened ore with lumps averaging two inches in diameter, but now, because modern methods of concentration yield a very fine product, the blast furnace is little used. A fine concentrate cannot be worked satisfactorily in the blast furnace. Owing to the great success of flotation as a method of concentrating sulfide ore there is at present, in handling oxide ores, a tendency to mix them with sulfide ores and then proceed with the regular sulfide process of reduction. Although the sulfide smelting process involves many more operations, the advantages of the sulfide concentrating process more than offset any objections that may be offered against later steps in the procedure.

Of the three classes of copper ores, the sulfide group is the most difficult to smelt. The process is complicated because in addition to the sulfur it is necessary to remove the large quantity of iron which these ores carry. In most cases small quantities of lead, arsenic, antimony or other elements are present and these metals must also be eliminated. However approximately three-quarters of the copper derived from domestic sources comes from sulfide ores.

Since the ores differ greatly in composition, the smelting process also differs in different localities. In general the steps consist of concentrating, roasting, smelting, converting, and refining.

Concentration

Concentration is necessary only with low grade ores. The older methods of concentrating ores by crushing, grinding, and washing often left as much as thirty percent of the copper in the rejected tailings. Comparatively recently a new process known as flotation has been developed in which ninety-five percent of the copper is saved and two thirds of the ore is discarded. The operation of the flotation process involves a peculiar phenomenon. In the liquid in which the ore is treated the heavier mineral particles are made to rise and the lighter rock particles or gangue sinks.

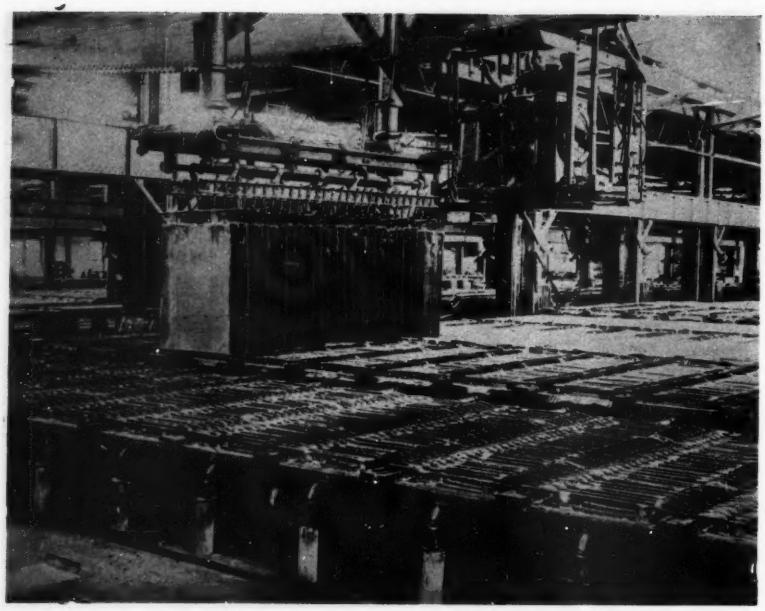
Huge copper converters containing copper matte which is converted into blister copper in these furnaces.

The process is carried out as follows: The ore, after being ground up very fine, is worked into a slime with water in the presence of less than one percent of coal tar and creosote. When the proper small quantity of the tar creosote mixture is used some change takes place on the surface of the metallic or sulphide particles which make them less easily wetted by the water. The gangue is not affected by the oily reagent and is therefore wetted by the water. This selective wetting effect can be increased by the use of acids or alkalies. The ore ground with the oily reagent and water is put in a larger volume of water containing a frothing reagent. The whole mass is then beaten or blown until a froth or foam is produced. The oiled mineral particles adhere to the froth bubbles while the waste matter or gangue settles out. The froth should be of sufficient permanence to last until it can be removed from the rest of the liquid and then, after removal, must quickly die away. When the froth has subsided the slime remaining is dewatered in a filtering device and the oil is distilled for further use.

Roasting

The ore after concentration, if it is necessary, is roasted to expel the volatile oxides of arsenic and antimony and to oxidize about three quarters of the sulfur present to sulfur dioxide, which is subsequently used to make sulfuric acid. After the oxidation is started it continues by itself without additional fuel. By roasting, the sulfur content of the ore is reduced from thirty-three percent to about eight percent, and a part of the copper and iron sulfides are converted into oxides.

The roasting furnace contains several hearths, one above the other. The ore is fed into the top hearth and gradually passes down the furnace from one hearth to the next. The hearths are enclosed in a cylindrical shaft and the heat required to start the roasting is supplied by burning fuel at the bottom of the shaft. The hot gasses along with air rise up the shaft through the descending ore. The ore is made to pass from one hearth to the next by means of rabble arms which are connected to a central revolving shaft. One set of rabble arms revolve slowly above each hearth and push the ore toward an opening through which it drops to the next hearth. The openings are placed alternately at the outside and inside of the periphery on alternate hearths. The rabble arms constantly stir the ore and cause it to progress through the furnace.



Rack of cathodes suspended over the electrolytic bath in the electrolytic cell room of a copper refining plant.

This type of furnace provides for the desirable features of stirring, gradual heating, and fuel economy.

Blast Furnace

While still hot the product of the roasting process is placed in a smelting furnace. Smelting was formerly done in blast furnaces. The copper blast furnace, in contrast to the iron blast furnace, requires a much weaker reducing action, a lower temperature, a much smaller fuel consumption, and a lower blast volume and pressure. The blast is never preheated. The distance from the tuyeres to the center of the furnace must be kept small in order that the blast may penetrate to the center. Consequently the furnace is made rectangular instead of circular with the width varying but little from about forty-two inches but with the length being made as great as desired to give the needed capacity. The charge cars run on tracks along both sides of the furnace and dump directly into it. The fuel is coke, the amount varying from three to four up to about eighteen percent of the charge. Matte and slag are not tapped from the furnace but run out together continuously from a spout, flowing into a settler outside the furnace. The settler is a reservoir in which the matte collects through settling to the bottom while the slag overflows continuously from the top. The matte is tapped out of the settler as needed.

The present trend in copper smelting is toward the discarding of blast furnaces in favor of reverberatory furnaces. The two leading points in favor of a reverberatory are its adaptability to the smelting of flotation concentrates and its lower fuel costs due to the possibility of employing cheaper fuels than coke. Another advantage is that less copper is lost in the slag because settling takes place in the furnace istelf.

Reverberatory Furnace

The reverberatory furnace is fired from one end with bituminous coal burned on a grate, gas, oil, or powdered coal. No fuel is mixed with the charge. The charging is done near the firing end of the furnace usually through holes in the side walls near the roof of the furnace with feed pipes coming from hoppers above the furnace or else by means of screw feeders near the top of the furnace. The slag runs off at the opposite end continuously in the large furnaces but smaller ones are tapped for slag as well as for matte. Reverberatories don't require settlers, the matte being tapped from the furnace at a point in the side near the flue end. These furnaces are built in very large sizes, the largest smelting as much as 85 tons of charge in 24 hours. They are always equipped with waste heat boilers and when credit is given for the steam so produced their fuel economy compares favorably with that of the blast furnace.

To the charge of roasted concentrate, known as calcine, sand is added, unless it is already present in the ore, in order that it may combine with the iron oxide to form a slag. Lime is also added to form a calcium silicate which makes the slag more fusible and less sluggish. By means of the slag much of the iron is separated from the copper in the form of iron silicate. Any iron pyrite remaining in the charge is converted into ferrous sulfide by distilling off the excess sulfur. Part of the ferrous sulfide is converted into ferrous oxide which enters the slag. With the remaining ferrous sulfide the cuprous sulfide forms a melted mixture which is denser than the slag and collects below it. The mixture is known as matte. Besides the sulfides of iron and copper the matte contains a considerable amount of metallic copper, a little metallic iron and any gold, silver, or other heavy metals that were present in the ore.

Convertors

The matte is converted into metallic copper in a Bessemer converter of side blown type with a basic lining of magnesite brick. Copper converters are steel shells with a thick lining of magnesite brick. A recent type, the Pierce Smith Converter, is in the shape of a horizontal barrel 30 feet long by 13 feet in diameter. There is no water or other cooling device. The temperature in the converter should be kept below 1200° C. to avoid destruction of the lining. This is accomplished by limiting the rate of air supply and by stopping the blow occasionally and adding cold scrap or other material. The converter slag contains 1/5 percent copper and is usually put back into the smelting furnace.

A charge of melted matte and a little sand or raw ore are put in the converter and air under pres-

(Continued on page 26)

PERSONNEL AND EMPLOYMENT

By PROF. PAUL H. BLACK

Personnel Advisor

The first contact of the student with the Personnel and Employment Office comes early in the last year of his course when he is called for a personal interview. During the interview the Personnel Advisor of his School discusses with him the various types of engineering opportunities and endeavors to learn from the records and from the student himself the type of work for which he is best suited. The records show the opinions submitted by the student's teachers during the first years of his course, and by a committee of five faculty members and five fellow students appointed by him before the interview.

During the interview the student is encouraged to discuss his vocational aptitudes and personal preferences, and in this manner the student's ideas begin to clarify themselves and the Personnel Advisor learns a good deal which will be of value when the representatives of industrial institutions visit the College. Thus his Personnel Advisor is able to record that, for instance, Mr. John Brown who expects to receive his B.M.E. degree in June has a preference for work in heat power engineering, and his aptitudes (in the overlapping fields of research, design, development, application, manufacturing, service and sales engineering) lie more nearly in the development field.

The interviews by the representatives of industry begin each year as early as February and the student has an opportunity to learn first hand by personal interviews about the activities and opportunities of the various companies which further clarifies his mind on the type of work for which he is best suited. After the interview the representative discusses the men with the Personnel Advisor and as a result the student may receive an offer for employment which, if he accepts, will be a milestone in his professional career.

In this manner the main objective of the Personnel and Employment Office of the College of Engineering is fulfilled: to assist the candidate for graduation to obtain the best available position in the field for which he is suited, and in which he will find greatest rewards in terms of happiness and monetary returns.

Personal Attention

This Office has earned a unique and enviable record among industrial and educational institutions on account of the personal attention it gives to each student approaching graduation and also on account of the complete records it has for each man. The record card for each man has his picture when he entered Cornell and another taken just prior to graduation. It has in addition to personal data a record of his average and cumulative average grades for each term and his class standing, extra curricular activities, professional society membership, personality and vocational ratings, and a record of employment after graduation. This information is confidential and is revealed to third persons only as judged proper.

The office, which was organized in 1938 by Dean Hollister, is under the direction of Assistant Dean Chamberlain who is also Personnel Advisor to the Electrical Engineering students. The Civil Engineers are served by Professor Perry, the Chemical Engineers by Professor Rhodes and the Mechanical Engineers by the writer. This organization makes it possbile for the advisor to become acquainted with each graduate of his School, and for coordination of the activities of the entire Office.

A number of alumni who may be seeking employment avail themselves of the service of this office in which its facilities in this connection work in cooperation with the University Placement Service in Willard Straight which serves

(*Continued on page* 28)

THE AUTHOR

Prof. Black

Paul H. Black is Professor of Machine Design and Personnel Advisor for Mechanical Engineers. Born in Huntingdon, Pa., he received his M.E. degree from R.P.I. in 1925, and his M.S. from U. of Pittsburgh in 1931. He taught at R.P.I. in 1925-26, and at the U. of Illinois from 1928 to 1937. He was associated with Westinghouse Electric Corp. in 1926-1928, and in the summers of 1929-1935 with U. S. Steel Corp. He joined the Cornell faculty in 1937. Prof. Black's field of major interest is in lubrication and bearing design. He is a member of Sigma Xi, Phi Kappa Phi, Atmos, A.E.Eng.Ed., A.S.Lub.Eng., Am. Gear Manu.Ass., and ASME.

AVIATION'S HOT AIR ANTI-ICER

By WARREN R. HIGGINS, ME '49

The last five years have brought on much research delving into the field of aeronautical engineering and its many wartime problems. A number of the solutions to these problems can readily be used for civilian flying safety. One of the foremost developments has been the elimination, by heat, of ice forming on the wing and tail surfaces of airplanes.

Ice, one of Nature's greatest barriers to safe flying, has been justly feared by pilots since the beginning of aviation. Icing affects aircraft in five principal ways: (1) it reduces the efficiency of the airfoil, and raises the stalling speed; (2) it makes the airplane difficult to control and maneuver; (3) it increases the drag of struts, fuselage, radio mast, fixed landing gear, etc.; (4) it increases the load; and (5) it causes certain flight instruments to give false indications, or to fail completely. To combat these often times disastrous effects aircraft manufacturers, airline companies, and the Army Air Forces together developed three systems, chemical, mechanical, and hot air elimination of ice.

Chemical de-icing fluid is used on the leading edge of the airfoil. It acts just as salt does on iced sidewalks but is not practicable for common use today.

Mechanical de-icing consists of a pulsating rubber boot that is fitted on the airfoils' leading edge. The three tubes contained in the boot alternately inflate and deflate, thereby loosening and cracking the ice layer formed. The ice is then blown away by the slipstream. This system has been in use for years in the majority of "all weather" aircraft in the United States. However, notable disadvantages accompany this de-icer. Often rough ice forms on the top of the airfoil, beyond the de-icer's effect, which causes difficulty in controlling the plane. Because of their "spoiling" effect on the airflow, boots cannot be in operation during slow flying, takeoffs, or landings. As better planes require smoother surfaces, the lowered efficiency of using rubber de-icers becomes increasingly objectionable.

The Lockhead Constellation powered by four 2200-hp engines, and equipped with wing and empennage de-icing heaters. *—Courtesy G.E.*

Hot Air System

Hot air elimination of ice is simple, efficient, and practical. Hot exhaust gases from the engines are used to heat air which is supplied, through ducts, to the leading edge of the wing and tail panels. This prevents ice from even beginning to form. From there the heated air sweeps back through the airfoils' interior and is spilled out over the control surfaces, thus preventing icing of those surfaces' controls, too. Some of the heated air is deflected to the flight deck, for window defrosting and crew comfort, and to the cabin, for passenger warmth.

Three advantages are claimed by the hot air system: (1) there is no danger of ice caking on the top surface, or even of forming anywhere, on the airfoils to destroy l'ft or to increase drag; (2) there is no loss in aerodynamic efficiency in either the wing or tail surfaces, so it can be employed during slow flying, takeoffs, and landings; and (3) operation, and subsequent ice destruction or prevention, starts as soon as the engines are warmed up and can be utilized until the engines stop.

Conception and development of this thermal anti-icer was spread out over a period of years. Engineers throughout the country worked to get a satisfactory design. The

(*Continued on page* 30)

TAU BETA PI ESSAY

THE HONOR SYSTEM

By THOMAS M. BERRY, CE '47

ON my arrival at Cornell I was greeted by a member of the student body of the Civil Engineering School, who was a member of the Honor Committee. I was asked if I wished to abide by the Honor System and if I did to please write a letter to that effect and turn it over to the committee. I thought this was just a part of college I didn't know much about and it probably was just to impress newcomers.

A short time later I found out differently. I was elected to represent my class on the Honor Committee and have served on the committee to the present time, a period of about a year. In that time I have become familiar with the Honor Committee and the Honor System and also a great many of the members of the student body. Through this experience I am convinced that the Honor System is a very good thing for the students. I know that it has done me a lot of good.

Let me go back a little bit. I am a little older than the average student and have worked in industry for several years before coming back to school. In this time I was working for mining and construction companies, therefore I came to know a number of professional men of all types. Some of these men were fine upstanding citizens who were doing a good job all the way around. Others, and quite a few others, were not so upstanding. I don't believe that these men last mentioned had the vaguest idea of what honor meant. One man I worked for was the biggest liar I have had the misfortune of meeting. He would lie for no good reason at all and with no excuse for it. He did not mean to get anyone in trouble but lots of times he did. Then he was very sorry and would try to lie his way out of the situation. Another man was a great liar but not in the same sense. He would lie and not care whether he got you into trouble or not if he could further his own interests; incidentally he built up quite a good business and was doing right well the last I heard but his reputation still isn't worth a nickel. Maybe it is because of the times that he is doing well. I am pretty sure his misdeeds will catch up with him sooner or later. Another employer I had was the type who would always stay just inside the law in his dealings. He would stretch to the limit; someday he is going to stretch a little too far.

I am of the opinion that if these men had been exposed to the proper training and environment they would be different; they would have a code of ethics to live up to. This training should start in the home and be carried straight on through the schooling of an individual.

In our primary and secondary schools we are taught, in a rather perfunctory fashion, what honor is; but the students aren't allowed to practice their teaching. In all classes, exams, and tests, he is closely monitored. When the student is watched so closely he thinks it is smart to try to pull something over on the teachers; the pupils will try to cheat or crib. Now this is at a time of a very impressionable age when the character of a pupil can be very easily molded one way or another. This molding depends almost entirely on the teacher. Unfortunately teachers of high caliber who could make a good mold are sadly lacking in the teaching profession. This can be blamed on the low salaries which the public wishes on the teachers; it is the public's fault, and they are paying in the type of students that are turned out of the schools as finished products.

When a student arrives at college he is just turning to manhood. If at any time during his stay at college he is exposed to a system where he is on his honor and has a definite code of ethics to live up to, it is bound to make an impression on him. Understand, this will not work on all students the same way. There are always a few bad characters in a melting pot. Regardless of what system of schooling is used these bad ones are still going to fight it and take advantage in every way possible, and they will be the same way when they get out of school.

When a student is on his honor it certainly makes him think a little differently. I believe everyone has a conscience of a sort; when you are violating a code it is bound to make you feel a little uncomfortable. Therefore I think a student will try to do his own work a little harder and not depend on getting his neighbor to help him so much; this will be true either in class or out. It is much easier to take an examination when you don't have a proctor walking around peering over your shoulder. In some of the colleges these proctors keep a constant parade going around the room. This certainly distracts the student. I know that a proctor worries me and I can't do as good work as otherwise would be possible.

A code of ethics is certainly essential if a man is to become a good citizen and an asset to a community. If this code is started in school the young man is bound to benefit from it. He is taught a little of the responsibility that he will encounter in later life. In most cases he will be surrounded by men of good character because the bad ones are soon gotten rid of, if possible. Again I say the system is not perfect in that a few men are going to get by any way possible; this is human nature. But I am fairly certain that men of this lower moral type will not get as far as the man who has had the proper training and environment.

PROMINENT

Jim

James Gillin, ChemE

Jim Gillin, before becoming one of "Dusty's" boys, spent several years at Sewanhaka High School in Long Island, from which he later graduated. During his high school days, developing pictures for friends in his dark room kept him busy. Astronomy was another interesting hobby.

A winner of a prized McMullen Undergraduate Scholarship, he came to Cornell in the summer of 1943 and started on the accelerated program, but grew tired after six straight terms of Chem. E. and slowed down.

Even the dread "710," which haunted three of Jim's terms, twice when he was a student, once when assistant, didn't keep him from active participation in many activities. His mellow voice leads his brother (and sister) Chem. E.'s in song over a mug of "the usual" at the informal gatherings in Olin which often follow the more serious part of the A.I. Ch.E. meetings, of which he is vice-president. The Chem. E. "Quartette," ably directed by Jim, has rendered "Aura Lee" and other favorites, at various campus gatherings, such as a Graduate-Faculty Party where it helped entertain last year. And on Sundays Jim sings with the Sage Chapel Choir.

Twice his Alpha Chi Sigma fraternity brothers showed their faith in his leadership by electing him Master Alchemist; at the present time Jim is trying to plan bigger and better parties as social chairman of the "frat." Amusing incidents keep popping up at the house. Jim remembers the time all the water pipes froze at AXE when ambitious Chem.E's tried to drain them. This year he hopes to direct an original Chem. E. variety show, with lots of fun for both participants and spectators, of the "Hellzapoppin'" type. The whole cast will be composed of Chem.E.'s, and the show will be presented in Olin around springtime.

But Jim takes his studies in stride too, as is shown by his membership in Tau Beta Pi. He is also secretary of Al-Djebar.

In all his fields of endeavor, Jim's affability proves an invaluable asset; with his many aptitudes and easy manners, we know he'll reach the goal he's set for himself after graduation.

Jarman G. Kennard, ME

Ithaca is home to Jerry Kennard, M.E. '47, since he has lived here all his life. In Ithaca High he played football and was chairman of the debating team in his Senior year. However, he spent more time with motorcycles than on school activities. Asked why he entered the M.E. School, he replied that on graduation in 1939 he was appalled at the thought of working and chose to study in Sibley.

His first year here he strove his hardest on the second string Frosh hundred-fifty pound crew, the so-called "garbage scow." As a member of the Pershing rifle drill team, Jerry helped Cornell triumph over Syracuse and Penn State. During the summer of his sophomore year he learned to fly in the C.P.T. training program. Classes kept him busy too, but since his father taught his Physics 21 instructor, Jerry claims it was impossible to bust that course. The war interrupted his next year, and Jerry went into Army uniform in January of '42.

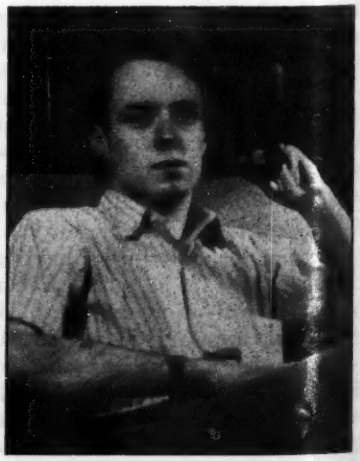
Ten months later he went overseas to fly B-24's out of Egypt and Libya, and adventure began. After a short but lively career, Jerry was shot down over Sicily on May 11, 1943. He was partially disabled at the time: he lost his right thumb and his right arm was crippled. The Italians captured but didn't keep him along. Although the first escape brought him only half an hour of freedom, the second lasted three months. Jerry operated with the guerillas behind the lines until the partisans turned into a group of bandits plundering for themselves. During this time he lived with an Italian family. He was recaptured and sent to Germany, but the Germans didn't mistreat him. Finally in September of '44 the long awaited day arrived, and Jerry was repatriated out of Germany on the *Gripsholm*.

The year he spent in U. S. hospitals didn't pass too slowly because he had 345 days of sick leave, and during this time he married a little blonde he had first met as a Freshman. He retired as a First Lieutenant the following September, just in time for the Fall Term here at Cornell.

Jerry rejoined A.S.M.E. in 1945. On returning home one day, he found a note tacked to his door that he had been elected Secretary of the organization. Evidently he did an excellent job, for he is hard at work as Chairman this fall. Last spring he became a member of Atmos and was made Treasurer.

(*Continued on page* 38)

Jerry



ENGINEERS

Edward J. Best, ME

"Hey, E.J." you hear his friends call as he fights his way from the Straight back to the old salt mine, Sibley. Ed came to Cornell in November of 1943 with the Navy. He says that he spent six months in the Navy doing nothing and then hit Cornell and did nothing but study and stand in line. Upon rigorous cross examination though, the fact did come out that he had found where the Dutch and Zinck's were located. (Ed. This might be called an understatement.)

Born in Brooklyn, he was a Xmas present in 1923, and a real package to his family ever since. He followed the family when they migrated to Garden City, Long Island in 1933. Ed claims that he just wandered around the high school for four years and had a very good time graduation night. The true story is that he played varsity football, co-captained the lacrosse team, and was cut from the basketball squad for four years. Ed insisted that I explain that this basketball episode occurred before he shot up to 5 feet 6 and 7/8's.

After high school he picked up his first trade, that of precision optician with the Perkin-Elmer Corporation of 535 Hope St., Glenbrook, Conn. If you are wondering about this detail, it happens that Ed plans to go back with them after graduation and figured that a little plug wouldn't hurt. The second trade was by no means as profitable or educational for as Ed puts it "I jockeyed a steam presser in a ship's service laundry."

Asked about his scholastic activities at Cornell, he mentioned something about the Dean's List, but added that he is strictly Mr. In-and-out because it only happened once. At this time though Ed is Treasurer of Tau Beta Pi.

Socially Ed claims to be held up by the unreliability of "Emma," the name by which his grey Ford is affectionately known. It seems in times of great need she always fails him with a flat tire or dead battery. Actually he does manage to get along and is a member of Phi Kappa Sigma and the Quill and Dagger Society.

Called very sarcastically by Nicky Bawlf "the fastest man on skates," Ed nevertheless managed to get two letters and two stitches out of two years of hockey, which isn't bad for the course. Ed has been playing lacrosse here on the hill for three years now and is captain of this year's squad.

When I asked Ed his plans for the future he claimed that he wants to lead a simple life. That is, simply make a lot of money in a hurry, then simply sit back and enjoy it. Simple, eh?

Ed

Thomas M. Berry, CE

Who are the engineering BMOH this year? Tom Berry is certainly one answer to that question. He is President of Tau Beta Pi, President of Chi Epsilon, and President of American Society of Civil Engineers at Cornell.

He was born in Culpepper County, Virginia, the land of Southern Gentlemen, on December 16, 1914. According to Tom, Culpepper County is near the Wilderness Battlefield, and their farm was called Battle Park Farm. When he was eight years old his family moved to

Tom

Fairmost, West Virginia, in the heart of the West Virginia Coal Fields and an industrial center. He attended East High School in Fairmont. He was interested in sports, but his forte was dramatics. He took part in several plays, and was President of Dramatics Club and of National Thespians. He was also one of a group that started a Student Government and Council.

After high school he attended a small local college for about a year and a half with a vague idea of being a doctor. However in 1934 he had to quit school and go to work. His first job was with a coal company where he started working in the office and was soon transferred to the field. He travelled from mine to mine and served as a sort of flunky to the General Superintendent. Later he was put in charge of maintenance work for the mines. In 1939 he took a job as foreman with a construction company doing gunite work, and in 1940 he changed to a small construction company doing general construction work. He worked there through the war, and was married in 1942.

In 1944 he was awarded a McMullen Industrial Scholarship to Cornell and began his school career as a freshman in the Fall. Tom says about his return to school, "I wanted to go back to school and get a C.E. degree since I could see I wasn't going to get too far unless I had the proper training. Since I have already worked as a construction man I am really interested in civil engineering and know

(*Continued on page* 38)

ALUMNI NEWS

R. H. Shreve, BArch. '02, died September 10, 1946. He was senior member of the firm of Shreve, Lamb and Harmon, New York City architects who designed the Empire State Building and several Campus structures. He organized the firm in 1924, and was chief architect for Parkchester, the country's largest slum clearance and housing project in New York, and for three others now in progress there. The firm designed the new Campus development of the College of Engineering, of which Olin Hall is the first building, and are architects for the proposed Materials Testing Laboratory. Shreve established the Shreve, Lamb and Harmon Fellowship, providing a year's employment in his office to the outstanding student of each graduating class in Architecture. Former president of the New York Building Trades Congress and director and president of the American Institute of Architects, Shreve served on the board of design for the World's Fair and as chairman of the International Congress of Architects in 1939.

Alfred L. Boegehold, M.E. '15, has been nominated president of the American Society for Metals for 1946-47. Mr. Boegehold is head of the metallurgy department of General Motors Research Laboratories and holds numerous metallurgical patents. He was designated a Modern Pioneer by the National Association of Manufacturers in 1940.

Joseph Galluchat Tarboux, E.E. '23, M.E.E. '26, Ph.D. '37, now Professor of Electrical Engineering at Cornell, has been appointed chairman of A.I.E.E. committee on education for 1946-1947. Prof. Tarboux was instructor and assistant professor of E.E. at Cornell from 1919 to 1929, when he joined the faculty of the University of Tennessee. He returned to Cornell this year.

Ralph Bown M.E. '13, M.M.E. '15, Ph.D. '17, formerly assistant director of research, Bell Telephone Labs., N. Y., has been named director of research. While at Cornell he was elected to Eta Kappa Nu, and was a member of Varsity Track 1911-1912. In 1927, Dr. Brown was President of the Institute of Radio Engineers and won the Liebmann Memorial Prize for greatest radio engineering advancement in that year.

Mr. Syme

John P. Syme M.E. '26, has been elected Vice-president and Assistant to the Chairman of the Board of Johns-Manville Corporation. Mr. Syme joined Johns-Manville in 1926, and has been a senior officer and President's assistant since 1945, having previously directed the company's Industrial and Public Relations. He belongs to the University Club, the Cornell Club of New York, Essex Yacht Club and is a member and past president of the Cornell Society of Engineers.

Joseph Conn E.E. '33, has done away with annoying commercials on his radio. If one is coming, he merely claps his hands, automatically turning off his set. After the usual amount of time, he claps his hands again, and his radio turns on. Mr. Conn patented his "commercial eradicator" while working in the Navy's guided missle program. After the war he became a television engineer, working on his invention in spare time. His electronics gadget, a sound-operated relay, fits into a six-inch square box which can be attached to any radio. It can be used for other purposes such as turning lights on and off. So far Mr. Conn has had neither time nor materials to market his invention.

Elliott B. McConnell, BChem. '23, has been appointed vice-president in charge of manufacturing and elected a director of the Standard Oil Company (Ohio). He joined the company in 1928 and was made assistant to the vice-president in charge of manufacturing the following year. He is credited with fifteen patents in the petroleum field.

Albert Sears Crane, C.E. '91, retired hydraulic engineer and former vice-president of J. G. White Engineering Corporation, died August 26, 1946. He was assistant city engineer, Newton, Mass., after graduation; assistant engineer in City Works, Brooklyn, in 1895; chief assistant engineer, Lake Superior Power Co. plant, 1898; chief engineer of the same company in 1901; principal assistant engineer of Sanitary District, Chicago, in 1902; chief hydraulic engineer J. G. White in 1905; vice-president of J. G. White in 1913. In 1928 he became a consulting hydraulic engineer. During his career, Mr. Crane engaged in construction of thirty large earth dams, sixty masonry dams, forty hydroelectric stations, six irrigation projects. He was a member of ASCE, Western Society of Engineers and of Cornell, New York Lawyers and Brooklyn Engineers Clubs.

W. O. Kurtz, M.E. '15, retired from vice-presidency of the Illinois Bell Telephone Company, Chicago. Immediately after graduation from Cornell, Mr. Kurtz was employed by New York Telephone Co. He was made general manager of Illinois area in 1928, and was appointed vice-president in 1938.

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NEWS OF THE COLLEGE

Prof. Zimmerman

STANLEY W. ZIMMERMAN has been promoted from acting associate professor to associate in the high voltage laboratory. In 1930 he received the BS and MS in electrical engineering at the University of Michigan. From 1937 to 1944, Prof. Zimmerman taught apprentice courses for the General Electric Company, following which he taught at Rensselaer Polytechnic Institute. He has also worked with Detroit Edison Company on research in cathode ray operation with the Department of Engineering Reserach, University of Michigan on acoustic measuring equipment, and with the General Electric Company on various power projects.

PROFESSOR EVERETT M. STRONG of the Department of Electrical Engineering at Cornell was notified by the National Research Council that he has been appointed a member of that body for a three-year period. President Truman requested the perpetuation of the Council, and Professor Strong is one of the new men selected for membership. He will serve on the division of engineering and industrial research of that organization.

IN THE August-September issue of *Electrical Engineering*, C. C. Clymer and M. A. deFerranti wrote an article on "Electric Equipment for Cornell Variable Density Wind Tunnel." The article describes the Cornell Variable density wind tunnel from the viewpoint of electrical engineers and discusses principles governing the selection of electrical equipment for wind tunnels.

New Appointments

FRANK MASLAN is acting assistant professor in chemical engineering. From February, 1944 till this Fall he was chemical engineer in the research and development department of the Hercules Powder Company. Graduated in 1940 with the BS from the University of Illinois, Prof. Maslan received the MS in 1942 at the University of Missouri.

ROBERT M. MAINS has been appointed to the civil engineering staff. Since 1944 he has been with the applied physics laboratory at Johns Hopkins University. Graduated from the University of Colorado in 1938 with the BS in Chemical Engineering, he received the MS in 1940 at the University of Illinois, and the Ph.D. in 1946 at Lehigh University.

NORMAN RUSSELL GAY is now with the department of heat-power engineering. He received his BS(with distinction) at the University of Rochester in 1941, and his MS at Cornell in 1943. He has recently been with Eastman Kodak Company.

ROBERT LEE VON BERG recently joined the chemical engineering staff. With the DuPont industrial engineering division since 1944, he received the BCE and the MS in chemical engineering at West Virginia University, and the DSc. in 1944 from M.I.T.

ERNEST S. ELYASH, new graduate teaching assistant in physical chemistry this fall, graduated from Pitt, B.S. in chemistry, with highest honors in February, 1943. During the following year he did graduate work at Cornell, majoring in physical chemistry under Professor Debye. Then he took a war research job at the Franklin Institute in Philadelphia. "Ernie" is a member of four honorary fraternities; three national, Sigma Xi, Phi Lambda Epsilon, Sigma Pi Sigma, and one Pitt, Pi Tau Phi.

JOHN BAIRD of the Electrical Engineering School has been appointed to assistant professor. Formerly with the U. S. Bureau of Reclamation from 1936 to 1942, he received the BS and MS in E.E. at the University of Colorado in 1933 and 1934, and his DSc. from the Colorado School of Mines in 1940. He has served at Cornell successively as instructor in the Navy Diesel School, instructor in steam engineering, and as acting assistant professor in electrical engineering.

Prof. Ellenwood

PHI KAPPA PHI elected Prof. Frank O. Ellenwood, president for 1946-47; Prof. Lowell F. Randolph Ph.D. '21, vice-president; and Prof. Paul H. Black, machine design, secretary-treasurer.

(*Continued on page* 40)

Recent Developments In Engineering

Techni-Briefs

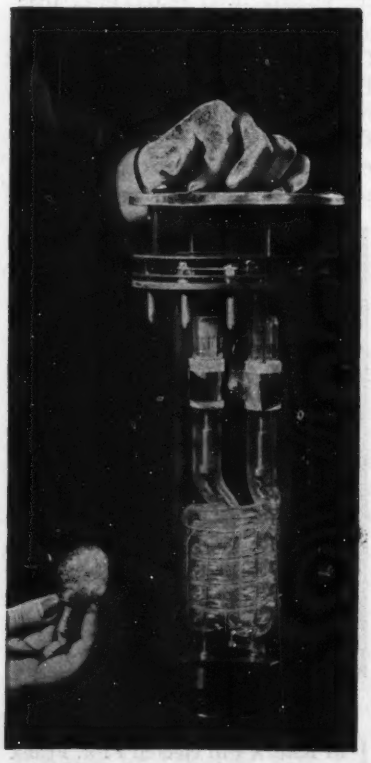
Picture-Taking

The repeating flash tube, which played an important war role in aiding night aerial photography, has been converted to peacetime uses. In addition to photographic applications, it is being used in airway and waterway beacons.

Its operation, according to GE, is based on the instantaneous discharge of electricity through an atmosphere of an inert gas. Powered by a special electronic source, the tube gives flashes of illumination so intense that night photographs are made possible from altitudes up to two miles.

The new Flash Tube compared with an ordinary flash bulb.

—Courtesy G.E.



Vertical Wind Tunnel

The new vertical wind tunnel looks like a de luxe silo, this sturdy structure of concrete eighty feet high. But there's no cattle food inside. This is a testing laboratory. Largest of its kind in the world, it is as well constructed and equipped as a Government lighthouse.

The test tube or "tunnel," centrally located within, is twelve feet in diameter and is lined with polished maple. It extends to the top where a big,four-bladed propellor, turned by a 1,100 h.p. motor, draws up an airstream through the tunnel and forces it down the annular passage between the inner cylinder and surrounding concrete wall. The ascending column of air serves to keep aloft models of new planes in free flight. By adjusting the pitch of the propeller, the velocity of the airstream can be controlled at will with the motor operating at a constant speed.

Tests are conducted from a recessed observation balcony opening into the tunnel throat halfway up the test section. Here, too, copper rings extending around the cylinder are installed on the inner wall and banded together, forming a part of the equipment for an electromagnetic control system we'll mention later.

The small wooden planes used in this wind tunnel have a wingspread of only two to three feet —about one-thirtieth that of a full-scale plane. They are built to amazingly exact dimensions and represent near perfection of the model-maker's art.

These miniatures are accurate to within one-hundredth of an inch; they are balanced by weights to within one-tenth of a gram. Each one contains a complete set of controls, including ailerons, flaps, rudders and elevators. All parts are operable by remote control with the precision of a pilot.

The test operator in the observation balcony is the pilot. He controls the flow of electrical current through the copper rings previously mentioned; and they, in turn, magnetically activate the controls of the plane. Thus, he can make a model spin, dive, climb or go through any other maneuver and watch its performance. But he doesn't have to rely on his memory of what happened—and that's where photographic film comes into the picture.

Synchronized motion - picture cameras located at the top and side of the test section of the tunnel are recording every motion and reaction of the plane in flight. The pictures are made at high speed and later projected at slow speed, so that the technicians can get a slow-motion view of the entire performance for intensive study. After the test, when the propellor stops functioning, the model plane, lacking any airstream support, is forced to land, not on the floor below, but in a resilient nylon net stretched across the base of the test section.

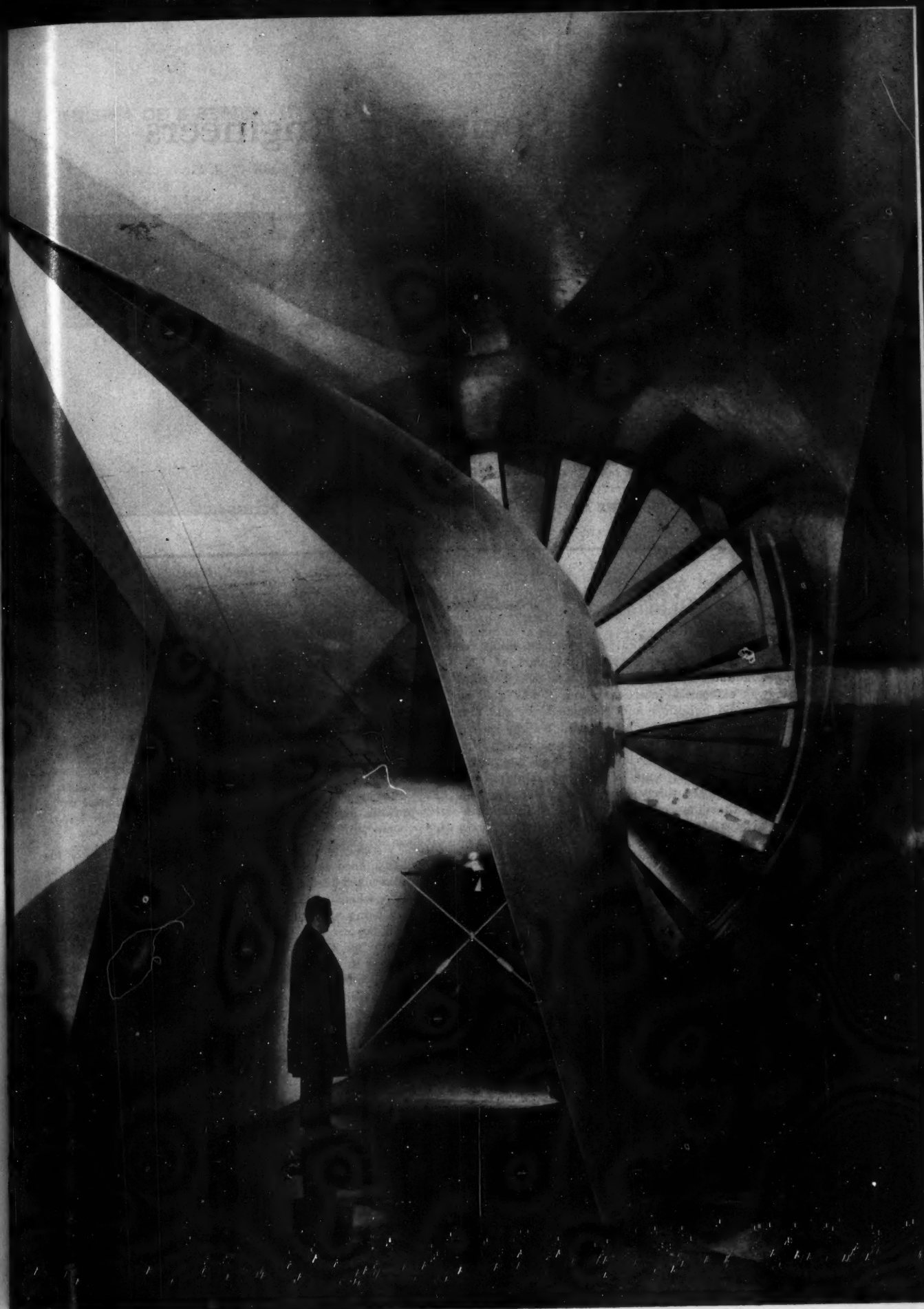
Aerodynamic tests with model planes of new types still in the blue print stage will, it is believed, result in the saving of large sums of money, working hours, and even the lives of test pilots.

As the experimentation and development of the helicopter continues, the vertical tunnel is expected to be the scene of much important research on rotor blades. Mounted on a streamlined hub at the base of the tunnel, model rotor blades can be tested for vibration and stress analysis while subjected to simulated flight conditions caused by the up-sweeping airflow. Parachute models will be tested for "sway" in the airstream and, when attached from beneath to a force recording mechanism, will be checked to determine the weight the chute can safely support in descent.

Germicidal Lamps

Up until recently the disease-producing germs that normally fill our indoor air have run into little or no opposition except the healthy resistance of the individual. Now

(Continued on page 34)



Interior view of the icing research tunnel in the Cleveland research laboratory of the National Advisory Committee for Aeronautics, shows air-driving propeller and fairing for propeller bearing

—*Courtesy G.E.*

Cornell Society of Engineers

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CREED W. FULTON, *Vice-President*.....4200 Wissahickon Ave., Philadelphia, Pa.

KARL J. NELSON, *Vice-President* .....112 Orange Ave., Cranford, N. J.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

I recently stopped at Buffalo to see first hand the facilities and equipment which constitute part of Cornell's new Graduatet School of Aeronautical Engineering. The visit was extremely interesting and I was glad to see these splendid buildings and equipment. It was also a pleasure to meet the keen staff Curtiss Wright assembled, who are to carry on for Cornell.

As I walked around the laboratory and hangars I realized how far we had come in both our thinking and accomplishments in the thirty years since I left Cornell. It so happens that the company with which I am connected has always been keenly interested in pioneering in many fields, one of which is aviation. In 1915 it was just developing the first instrumentation and automatic control for planes, and I soon became infected with the enthusiasm of Lawrence Sperry. I wrote to a professor in Sibley suggesting that, inasmuch as aviation was a coming thing, courses be started to train areonautical engineers. He replied to the effect that flying might be all right for a few brave individuals but it was doubted if it would ever amount to enough to warrant Cornell doing something about it engineering-wise!

More recently we have been lucky to have people like Dean Hollister, whose foresight and study were instrumental in securing these wonderful facilities for Cornell.

There is no question but that the air age in which we now live is rapidly bringing a profound change not only in engineering but in social concepts. The world has indeed shrunk into a relatively small sphere when, during the war, with equipment now out of date, one could leave London, as I did, at 2 in the afternoon and be in Washington at 9 the next morning.

It is interesting to learn that the World Congress on Air Age Education which was recently held in New York was attended by delegates from sixty universities in the United States and many foreign countries. The Congress attacked the new problems raised by the expansion of flight from many points of view. It was concerned with the ways in which advances in aeronautical science, followed by their economic, political and social implications, can best be integrated into the curricula of colleges and schools. As the New York Times said editorially in commenting on this Congress:

> ". . . It is, of course, a truism that nothing else has captured the imagination of youth so widely and so arently as aviation. The purpose of the Congress was to channel this enthusiasm into intelligent courses, and, beyond this, to form some common and wise use of the numerous technological advances which have come with the war and its aftermath."

Already the modern student has learned to look on the old-fashioned two-dimensional geography as out of date, and in many instances uses instead the new Air Age maps where, when using the United States as a center, we find when using air instead of water or land as a medium of travel, we are only 18½ hours from Moscow instead of 8 days by the fastest steamer and train. Many educators feel that it would be advantageous for students to study history from first-hand experience in visiting faraway lands. To this end engineers are giving serious thought to designing a special educational plane so that all the sciences which go with aeronautics could be studied en route. Such a plane, to be economical, must be able to carry to foreign lands large groups of students weighing an average of 120 lbs. instead of the customary 160 lbs. of adults.

* * *

In our Message last month we were unable to give you the complete MEETINGS COMMITTEE; we are now happy to report that Bill Reck has regained his health and can again help, so the following names should be added to your list:

William M. Reck, C.E. '14, Vice Chairman
Lewis M. Leisinger, C.E. '31, Vice Chairman
Robert B. Lea

NUMBER 4 OF A SERIES

Newsworthy Notes for Engineers

Cooking handsets with Radio Waves

After V-J Day, the demand for telephone equipment was at an all-time high. Total requirements for telephone handset handles, for example, were 33 per cent above the highest previous production rate. New molding presses would not be available for many months. It was up to Western Electric engineers to find a way to make these important parts *twice as fast* as they had ever been made before. So they called on wartime experience with electronic pre-heating of plastics—cooking with radio waves.

The method formerly used to produce the handles was to mold granular plastic into solid handles with conductor wires imbedded in them.

In the new method, granular plastic is first molded into a "pre-form", about the size and shape of a hockey puck. These forms are then "cooked" or heated to the consistency of butter by subjecting them to high frequency current—then placed in molds for final shaping. The new handles have hollow cores through which the insulated conductors are pulled.

This method doubles the output of handles, increases strength due to more uniform heating, improves finish, reduces amount of material used.

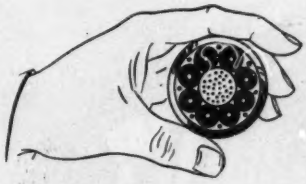
Coaxial Cable by the mile

To meet future needs for long distance telephone and television circuits, the Bell System is constructing a nationwide network of coaxial cable. Ingenious machines designed by Western Electric engineers are now turning out coaxials like spaghetti.

A coaxial unit consists of a copper wire supported centrally in a copper tube by plastic disc insulators. The copper sheath is covered by two layers of steel tape.

One machine punches out the plastic discs. A second machine feeds the discs through chutes onto wheels which force them onto the wire at precise intervals. The wire then travels through mechanisms which notch and form the copper tape around it and finally apply the double wrapping of steel tape.

All these processes are carried on continuously. Copper wire goes in one end of the machine—complete coaxial units come out the other end.



A cable like this, with eight coaxial units, can carry as many as 1440 telephone messages simultaneously—can handle television frequencies up to 2,800,000 cycles per second.

It takes 17,000,000 insulated pieces to make one part

It sounds fantastic—but it's one of the unusual feats accomplished by Western Electric engineers in producing compressed powdered cores for inductance coils used in the Bell Telephone System.

Thin "overcoats" of an insulating material are put on *every particle* of the molybdenum-permalloy powder of which the cores are made. The particles—averaging about 40 microns or 1½ thousandths of an inch in diameter—are coated with a minimum thickness of insulating material by precisely controlled mixing.

The resulting film has to meet three major requirements: It must not break away during compression and heat treatment of the core; it must isolate the particles electrically to reduce eddy current loss; it must remain chemically inert throughout the lifetime of the magnetic core.

Developing quantity manufacturing processes calling for scientifically controlled laboratory precision, is an interesting part of the complex, high quality production job for which Western Electric has long been noted.

Manufacturing telephone and radio apparatus for the Bell System is Western Electric's primary job. It calls for engineers of many kinds — electrical, mechanical, industrial, chemical, metallurgical — who devise and improve machines and processes for large scale production of highest quality communications equipment.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Mechanical Engineering

(Continued from page 9)

iods of work in industry. Such courses would be of considerable practical benefit to students and to their employers, as well as to the University. Such a plan would be in keeping with the policy of the School of close cooperation with industry. It is also very much a part of the policy of this School to cooperate closely and continuously with other schools and colleges of the University, including the Cornell Aeronautical Laboratory at Buffalo, as well as the new Graduate School of Aeronautics, the School of Business and Public Administration, and the New York State School of Industrial and Labor Relations.

New Facilities and Equipment

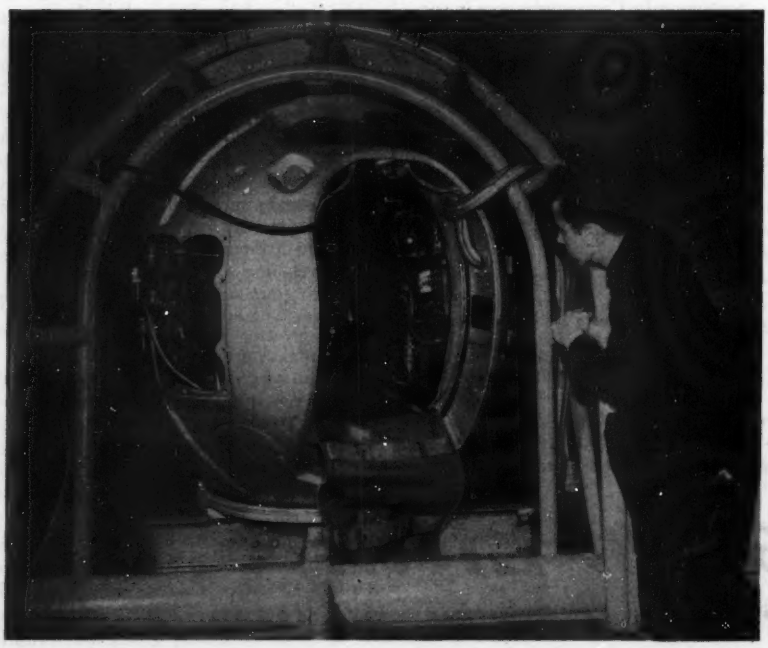
As this issue goes to press the formal transaction has just been completed, whereby the entire Diesel Laboratory, containing roughly two million dollars worth of the latest types of Diesel engines and associated equipment, established at Cornell by the Navy during the war, has been consigned to the University as an outright gift. This splendid collection of equipment will be utilized by the Sibley School for instruction and research in Diesel engine technology.

An excellent assortment of World War II aircraft engines, representing all of the principal American types, was obtained from A.A.F. surplus through the efforts of Professor Harry Loberg and is housed in Morse Hall basement. Two Type I-16 General Electric jet engines are mounted in the fuselage of the Bell P-59 airplane at the rear of the building. A German Jumo 004 axial-flow jet engine has been promised by Wright Field. Two complete production test cells, used to test Packard-built Rolls-Royce aircraft engines at Detroit, have been consigned to Cornell by the W.A.A. and are expected to arrive shortly. Plans are under way for installing the larger and noisier power plant equipment in buildings to be erected at the new Ithaca Airport, a short distance north of the campus.

A substantial and very useful addition to the air conditioning test facilities has been installed in the West Mechanical Laboratory. This equipment was described by Professor C. O. Mackey in a recent issue of this journal (Vol. 11, No. 8).

Professor Geer's Materials Processing Department has been made the custodian of about $50,000 worth of the finest types of modern precision gages and instruments, consigned to it by Army Ordnance. This equipment provides the School with a first-rate "Bureau of Standards" in the field of measurement of dimensions.

Part of the World War II aircraft equipment obtained from AAF surplus, now in Morse Hall.



Teaching

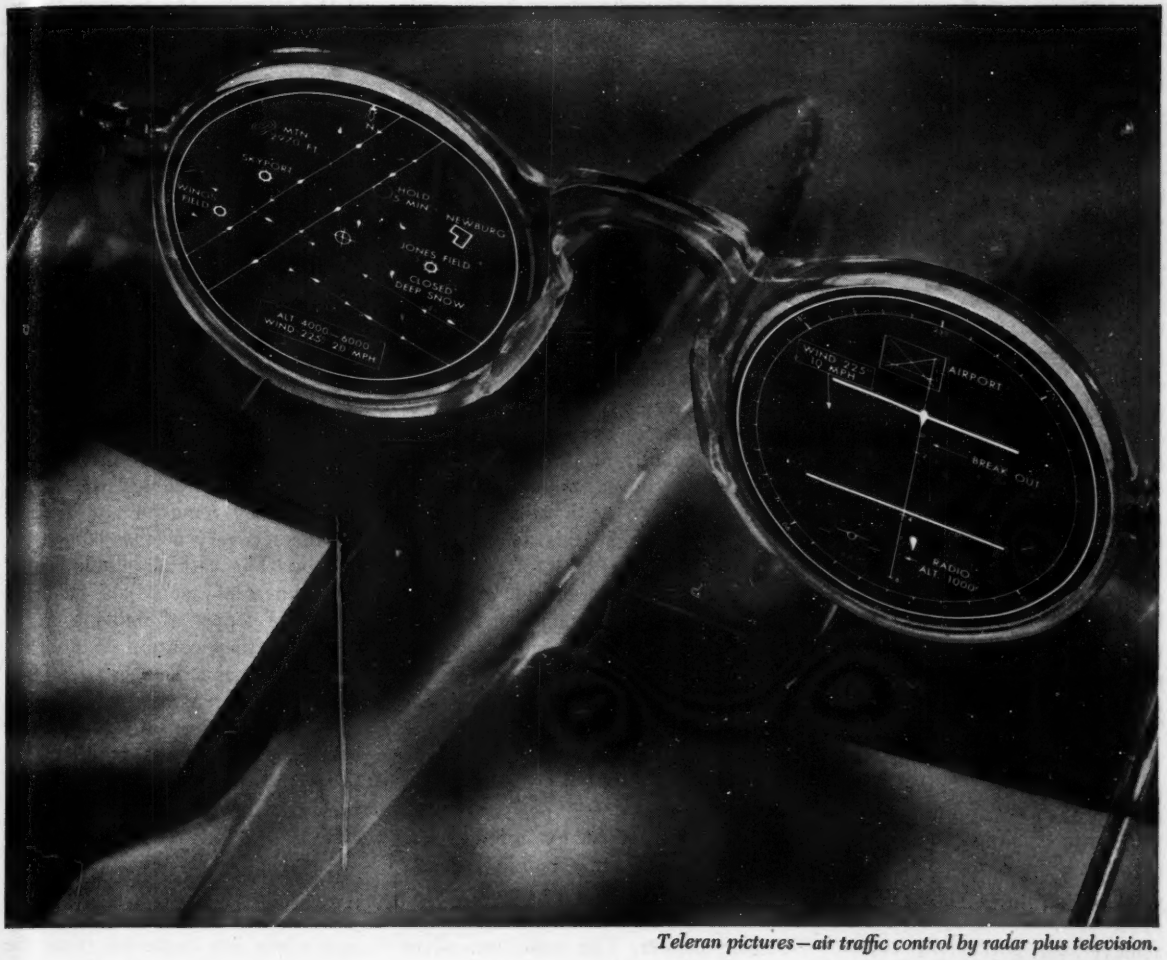
Teaching is, of course, the principal function of the Sibley School, and it is therefore only natural that particular attention should be given to the continual advancement of this important art. A committee headed by Professor Paul H. Black has been appointed to make a study of improved methods of teaching, to make certain that such methods are properly evaluated and utilized. "Visual Aids" of various kinds will be employed more freely. An attempt will be made to obtain more sectionalized displays of modern mechanical apparatus. In order to stimulate the interest of students, efforts will be made to obtain a greater supply of "live" unsolved or typical current engineering problems for use in class work. On the other hand, it is felt that a more adequate "museum" of older equipment would be valuable in illustrating the evolution of mechanical designs. Particular emphasis will be laid upon the development of mechanical ingenuity and "commercial instinct" in design classes—the latter term referring to the capacity for appreciating and anticipating the commercial appeal or marketability of a product.

As frequently as practicable, nonresident lecturers will be invited to bring fresh examples of advanced methods, analyses, and designs from industry. In all departments particular pains will be taken to recognize, support, and develop the kind of good teaching that maintains the enthusiastic interest of the students.

Research and Industrial Contacts

So long as it is not allowed to interfere unduly with the school's primary function of undergraduate instruction, engineering research is very helpful in maintaining good academic health, which is also true of industrial consulting activities.

(Continued on page 32)



Teleran pictures—air traffic control by radar plus television.

Teleran—"radio eyes" for blind flying!

It's a television "information please" between airplane and airport—with the pilot's questions given split-second answers on a television screen mounted in the cockpit.

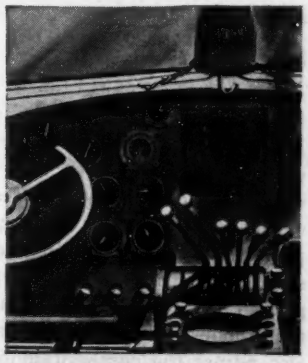
Teleran (a contraction of *TELE*vision—*R*adar *A*ir *N*avigation) collects all of the necessary information on the ground by radar, and then instantly transmits a television picture of the assembled data to the pilot aloft in the airplane.

On his receiver the pilot sees a picture showing the position of his airplane and the position of all other aircraft near his altitude, superimposed upon a terrain map complete with route markings, weather conditions and unmistakable visual instructions. The complex problem of air traffic control is well handled by Teleran.

Teleran—another achievement of RCA—is being developed with Army Air Forces co-operation by RCA Laboratories and RCA Victor, endless sources of history-making developments in radio and electronics. They are also your assurance that *any* product bearing the RCA or RCA Victor monogram, is one of the finest instruments of its kind science has yet achieved.

• • •

Radio Corporation of America, RCA Building, Radio City, New York 20 . . . Listen to The RCA Victor Show, Sundays, 2:00 P.M., Eastern Standard Time, over the NBC Network.



Instrument Panel of the Future. The Teleran indicator, mounted in a cockpit, simplifies the pilot's job by showing his position relative to the airport and to other planes in the vicinity. It promises to become one of the most useful developments in the history of aviation.

RADIO CORPORATION of AMERICA

Metallurgy of Copper

(*Continued from page* 12)

sure is blown through the liquid mass. The sulfur burns to sulfur dioxide and the ferrous sulfide is converted to ferrous oxide. As the ferrous oxide forms it reacts with the silica of the sand or raw ore to form a slag. When the iron has been slagged from the matte, the slag is removed by stopping the blast and pouring it off. The white metal remaining in the furnace is copper sulfide. The blowing is then resumed which oxidizes the copper sulfide to the oxide. The copper oxide formed reacts with some of the unchanged sulfide to yield metallic copper. Approximately five hours are required to complete these reactions. The copper produced is known as blister copper because the sulfur dioxide which was dissolved in the molten metal produces bubbles when the metal solidifies which look like blisters. This copper is 99 percent pure.

Since over half of the copper produced in the United States is used by the electrical industries and since the slightest impurities in the copper reduces the electrical conductivity, the copper must be at least 99.95 percent pure. To achieve this purity the copper is subjected to a refining process.

Fire Refining

Copper when refined by the older fire refining method isn't sufficiently pure but the process is necessary before the newer and more expensive electrolytic process is carried out because it removes impurities that would cause excessive fouling of the electrolyte, if present in too large an amount in the anodes. This refining process also adjust the composition of the copper to the point where flat smooth anodes may be cast.

Air is introduced beneath the surface of the molten bath through small steel pipes to oxidize the impurities. This operation is called flapping. The oxidized impurities rise to the top and form a thick slag, which is tapped and raked out through a door at one end of the furnace. There is also cuprous oxide produced which is absorbed in the molten copper. This cuprous oxide makes the copper brittle and therefore must be removed. It is removed by reduction which is accomplished by covering the molten metal with charcoal or coke and stirring with a pole of green wood. The poles are young trees of hardwood fifteen to twenty feet in length. The wood undergoes destructive distillation and the gasses that escape, in addition to having a reducing effect, cause a violent bubbling and stirring of the melted metal. Over-reduction must be avoided because the oxides of arsenic, antimony, and bismuth which are always present but not objectionable in the oxide form may be reduced, which will cause the metal to be brittle. The furnaces in which this operation is carried out are built of refractory brick fired, at one end with gas, powdered coal, or oil. Their capacities run from two hundred to four hundred tons of copper. The time this operation takes is twenty-four hours.

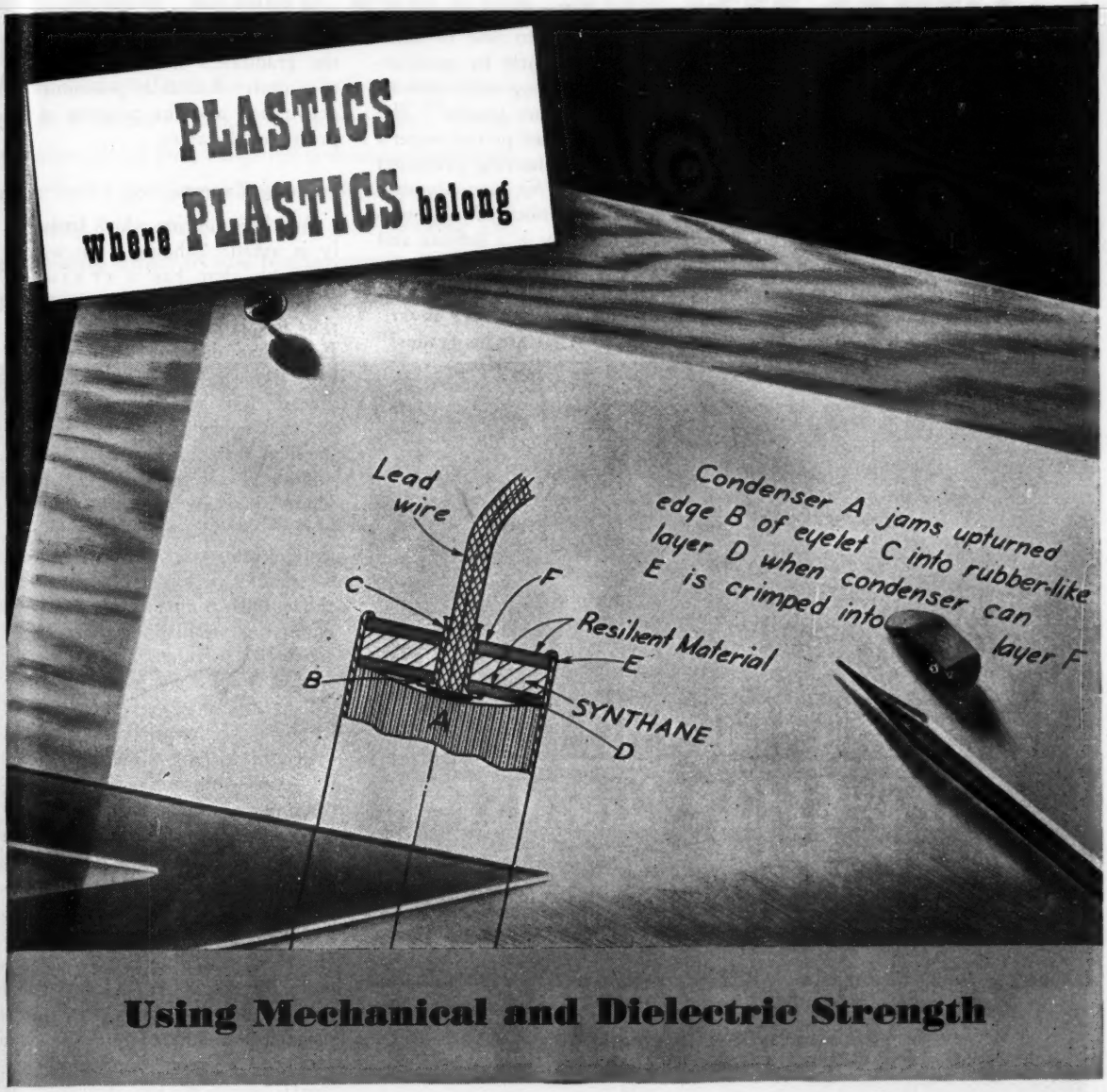
Electrolytic Refining

Copper of 99.95 percent purity can be obtained by refining the product of the fire refining process electrolytically. This process removes gold and silver from the metallic copper. The gold and silver are used to take care of the cost of refining. The impure copper is cast into rectangular plates which serve as anodes. These anodes have an area of eight to ten square feet and a thickness of more than an inch. They weigh about five hundred pounds. The cathode sheets are made from pure copper and are the same size as the anodes except that they are only one sixteenth inch thick. The anodes and cathodes are placed alternately in an electrolyzing vat with an electrolyte of slightly acidified copper sulfate. The voltage between each pair of electrodes is only 0.3 to 0.35 volts and the current density is fifteen to twenty amps per square foot of cathode area. An ampere efficiency of ninety percent may be expected. The main reaction which takes place is that the sulfate ion discharging at the anode reacts and causes an ion of copper to go into solution. At the same time a copper ion discharges at the cathode. The solution therefore stays at constant composition and the only work that is theoretically done in this main reaction is to transfer the metallic copper horizontally about two inches. A side reaction involving the electrolysis of water occurs to a small extent and wastes the electric current. The small amount of iron present in the copper anode goes into solution and accumulates as ferrous sulfate which must be removed from the solution periodically for chemical treatment. Gold, silver, and some of the objectionable impurities do not go into the solution but settle to the bottom of the vats as slimes which are subsequently removed and treated for the recovery of the value they contain. The cathodes build up to a thickness of nearly an inch and consist of copper of high purity except that they contain enough hydrogen to make them brittle. They are therefore remelted in a wirebar furnace which causes some oxidation and the excess oxide is reduced by poling. The product is then cast into pigs or bars for market.

Heavy Metal Refining

The slimes containing the gold and silver are removed from the electrolytic tanks and pumped to the department known as the silver refinery. Here they are roasted at low temperatures to convert the copper to the oxide state. The roasted slimes are then leached with fifteen percent sulfuric acid which dissolves out most of the copper and arsenic. The next step is smelting the leached slimes in small reverberatory furnaces called doré furnaces. This operation is one of oxidizing and slagging practically all of the remaining impurities. The product is called doré metal which analyzes about 96% silver, 2% gold, and 0.5% copper. In the doré furnace three fluxes are commonly employed with removal of slag between each addition. These fluxes are silica, soda ash or caustic soda, and niter. Lead and some antimony are slagged first making a slag that is sent to a lead smelter. Oxidation is assisted by blowing air through the bath and finally the addition

(*Continued on page* 42)



Using Mechanical and Dielectric Strength

SYNTHANE laminated phenolic, sandwiched between and bonded to layers of a resilient material, is the basis of an interesting plastics application.

The assembly—a condenser—depends upon the resilient material for a perfect seal when the edge of the can is crimped. Synthane backs up the resilient material, provides needed strength and rigidity, and is also an excellent electrical insulator, unaffected by condenser oil.

Synthane Fabricated Parts are produced by men who know how to make plastics and how to machine them, using specialized equipment. Synthane Corporation, Oaks, Pennsylvania.

SYNTHANE TECHNICAL PLASTICS DESIGN • MATERIALS • FABRICATION

Employment

(*Continued from page* 13)

the alumni of the entire University.

As an additional service, this Office contacts by mail each graduate every year for the first five years after graduation and thereafter every five years, and in this manner keeps up to date the graduate's record. As a result of this survey, a directory of each man's class is compiled and mailed gratis to him. This enables each graduate to keep in touch with his former classmates.

Importance of Grades

It is interesting to refer to questions asked frequently by graduating engineers seeking employment. "How important are grades?" The answer to this, based on the writer's several years engineering personnel experiences and his acquaintance with a large number of representatives of industry, is a definite and unequivocal "very important." After the student's name, the next question the representative invariably asks is "What are his grades?" Other qualifications than grades, such as integrity, character, personality, drive, and appearance affect the graduate's success in securing the most desirable positions on graduation and the progress of his professional career.

Training Courses

Another question which frequently is asked: "Should I go with a company that has a training course?". The answer to this question lies largely in the individual. If he has decided what type of work he wants and is really convinced that his choice is correct, he may as well begin his work in the field of his interest without considering a formal training course. There are some men who say, for instance, "I like machine tool work and nothing else will satisfy me." He should go directly with a machine tool company. Many men graduating today, however, have not had opportunity to decide what type of work they would like, but realize only that they have a good technical background and are now ready to learn by experience the types of work for which they are suited. For this group the writer recommends a larger company with an organized training course. A good training course affords an unparalleled opportunity to obtain a broad knowledge of industry in general, both about technical and human aspects. After a few months on such a course, most men's ideas begin to crystallize and they are able to say that their major interest lies in design, development, manufacturing, service, or sales engineering. They enter then the field of their choice with confidence and with saving in time over what may be the case if they started in the wrong field. Most companies pay a somewhat lower initial salary during the training course than the man may receive in a more specialized position. This means a loss in income for a few years in starting but experience has shown that there is generally a gain in income in later years.

Many men have fear in entering a training course with a large company feeling that they may become "lost" in the company. The

(*Continued on page* 30)

ZINC INSTITUTE 2 OZ. COATING SEAL OF QUALITY

The "Seal of Quality", shown above, is the yardstick of economy in buying galvanized sheets. It signifies at least 2 oz. of Zinc per square foot!

The U.S. Bureau of Standards, Circular #80, says, ". . . by far the best" protective metallic coating for rust-proofing iron or steel is ZINC. Zinc, in the form of galvanizing, protects against rust in TWO WAYS: First, by simple coverage, with a sheath of rust-resistant metal . . . Second, by electro-chemical action, or "sacrificial corrosion." That's why industry has long depended on ZINC to stop rust—cut costs—save materials. Heavy coatings pay—for the heavier the coating, the better the protection, the longer the service life and the lower the cost.

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WRITE TODAY for these valuable booklets: (1) Repair Manual on Galvanized Roofing & Siding (2) Facts About Galvanized Sheets (3) Use Metallic Zinc Paint to Protect Metal Surfaces (4) The Zinc Industry—Mine to Market.

American Zinc Institute

Room 2618—35 East Wacker Drive, Chicago 1, Illinois

ONE MORE STRAW—ONE LESS CAMEL!

Many centuries ago the weight of one last straw broke a camel's back. Thus somebody's artless optimism about the strength of a vital part wrecked a perfectly good materials handling system.

Today it is plain, cold fact that ignoring the depressing effect of low temperatures on the impact strength of vital steel parts can be a short cut to a long line of avoidable, costly troubles.

The solution for the problem in the fable was less load or more camel. For the modern problem the answer is a molybdenum steel that combines the deep hardening and freedom from temper brittleness necessary to provide good low temperature impact strength.

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MOLY

Employment

(*Continued from page* 28)

writer feels that the man who may become lost in a large company would with equal facility reach his ceiling in a smaller company.

Design vs. Administration

Another frequent question is "I do not feel qualified for technical work. Don't you think I would make a better administrator or sales engineer than a designer? The answer here is that there is no great difference between the broad technical requirements for an administrator or a sales engineer or a design engineer. All require a thorough knowledge of fundamental principles and the ability to use this knowledge. It is significant that of the top executives of one of our largest corporations, 48.4 percent originally held design positions within the company. This points out that technical experience and training is a good prerequisite for the top executive positions, in the same manner that a high scholastic record is a good prerequisite for high grade initial employment.

In answering these and many other personal and technical questions, and in providing the seasonal guidance of advisors who know the detailed history of many former graduates, and who have the interest of the individual at heart, this office attempts to reach its objectives in assisting the College of Engineering graduates to attain the benefits of satisfactory employment.

Anti-Icer

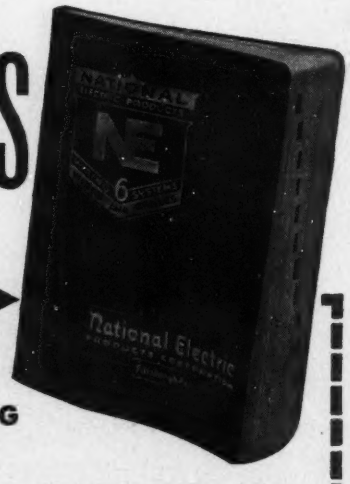
(*Continued from page* 14)

National Advisory Committee of Aeronautics and the Government Research Agency collaborated with aircraft manufacturers to design a better ice eliminator than the rubber boots. Consolidated Vultee Aircraft Corporation and Lockheed Aircraft Corporation were both among those on the job in its development. The Army Air Forces Ice Research Base at Minneapolis, Minn. was established to help fight the ice menace; thermal anti-icing was but one possibility to be investigated. Some guess work and a great amount of straight-forward engineering went into the development of the heated wing. At the outset models were used for the

(*Continued on page* 36)

YOURS

for the asking . . .



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We are expecting and getting, many registrations of Cornell veterans. They are welcome.

Du Pont *Digest*

Items of Interest to Students of Chemistry, Engineering, Physics, and Biology

New Plastic Resists Heat, Acids, Electricity

"Teflon," Product of Group Research, is Solving Difficult Problems in Radar, Television and Industry

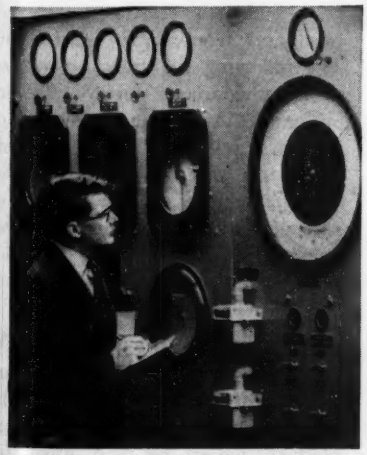
A group of Du Pont research men were looking for a new refrigerant of a particular type. These men found what they were after; but, as so often has been the case, they found something more—this time an industrial plastic whose unique qualities make it invaluable in many fields.

During the study, the chemist in charge proposed a route to the synthesis of HCF_2CF_2Cl via tetrafluoroethylene, $CF_2=CF_2$. In working with the latter, a chemically reactive gas boiling at –76.3C./760 mm., it was learned that it polymerized to form a resin having unusual properties.

After evaluation by organic and physical chemists, physicists and electrical experts, a suitable process for the difficult manufacture of this product was worked out by the chemists in collaboration with chemical and mechanical engineers.

Structure and Properties

"Teflon" is made by polymerizing gaseous tetrofluoroethylene to give a solid, granular polymer:



Controlled at this one panel is all the equipment for producing the polymer from which is made "Teflon."

"Teflon" (right) resists boiling acids and solvents to a degree unrivaled by other plastics.

$$n\begin{pmatrix} F & F \\ C & = & C \\ F & & F \end{pmatrix} \rightarrow \ldots \begin{matrix} F & F & F & F \\ C & - & C & - & C & - & C \\ F & F & F & F \end{matrix} \ldots$$

The fluorine atoms in the molecule impart exceptional properties of resistance to heat and chemicals.

"Teflon" has unusual heat resistance. Having no true melting point, "Teflon" decomposes slowly to give the gaseous monomer and a few other gaseous fluorine derivatives at around 400°C. Under certain conditions small amounts of fluorine-containing gases have been observed at temperatures above 230°C. Because of its heat resistance, gaskets and wire insulation for jet engines are now made of this plastic. It is also used in aircraft ignition systems near sparkplugs and in high-temperature heating systems.

The chemical resistance of "Teflon" is such that it withstands the attack of all materials except molten alkali metals. Boiling in acid (aqua regia, hydrofluoric acid or fuming nitric acid) will not change its weight or properties. For this reason it may have wide use in such applications as tubing and piping for chemical plants and acid-distillation equipment.

Because the dielectric loss factor is extremely low, even at frequencies up to 3000 megacycles, it is an excellent insulating material for currents of ultra-high frequency. Its heat-resisting and aging qualities suggest immediate uses as a dielectric in coaxial cables for color television, and in radar and power fields.

Forms of "Teflon" Available

By use of special techniques the new plastic can be extruded as rods, tubes or wire coating. In general, its extrusion rates are low in comparison to other thermoplastics because of its resistance to softening.

More facts about "Teflon" are in Du Pont Plastics Technical Service Bulletin No. 13. Send your request to 2521 Nemours Bldg. Wilmington 98, Del. "Teflon" is one of the many products which represent the work and skill of Du Pont men, who, working as a team, contribute toward a better America for you and all of us.

Questions College Men ask about working with Du Pont

"WILL I STAY IN ONE FIELD AT DU PONT?"

The first position of a new man at Du Pont is based on his expressed preference and an estimate of his aptitudes and abilities. Subsequent work may be in the same or other fields, as openings present themselves in research, production or sales divisions. Keynote of Du Pont personnel policy is promotion from within on a competitive merit basis.

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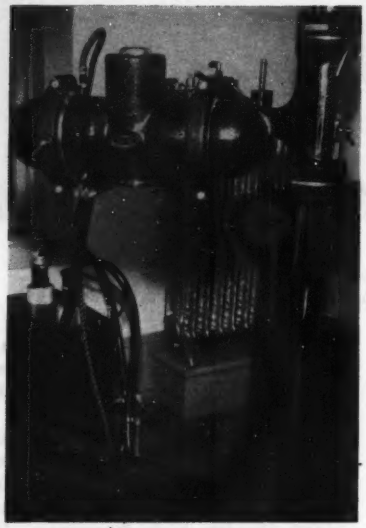
WILMINGTON 98, DELAWARE

More facts about Du Pont—Listen to "Cavalcade of America," Mondays, 8 P.M. EST, on NBC



New X-ray machine for testing in Engineering Materials Lab.

Mechanical Engineering

(*Continued from page* 24)

Both activities are refreshing and stimulating to the faculty and graduate student alike. Because it is entirely disinterested commercially and free from the distracting pressures and priorities of production, the School is in a favorable position to carry on long-range research, as well as shorter development projects, and to contribute materially to the scientific and technical progress of the country. With its augmented facilities as mentioned above, Sibley is ready and willing to do its proper share.

The Future

At no time in its 78 years of history has Sibley's future held so much promise of interesting new worlds to conquer as at the present moment. The prestige of the School has magnified the postwar flood of new applicants for admission, and there is ample reason to expect that quotas will be filled with very select numbers of exceptionally well qualified students for years to come. With such top-grade material to work with, a faculty and staff second to none, more and better facilities than ever, and unstinted support from the University administration, the outlook for the future is very good indeed.

On the other hand, there is no time for complacency. The past record of the School provides a tremendous challenge to maintain its prestige and its leadership in the midst of vigorous new competitors. Several contemporary engineering colleges are making good use of ample financial resources, together with very commendable talent and enterprise, to build up excellent reputations of their own. It has even been said that mechanical engineering itself is being eclipsed by the progressive new professions of chemical and metallurgical engineering. Meanwhile, the faculties of all types of schools are being raided by industry and government with lucrative offers that cannot be approached within normal academic budgets. The more reputable the school, the more vulnerable it is in this respect.

The implications of this state of affairs are obvious. The Sibley School must take careful stock of its assets—many of which have been enumerated above—and exploit them to the utmost with energy, resourcefulness, and vision. The initiative in this respect must not be left to the administration alone. The job cannot be done adequately without the participation of faculty, staff, students, and alumni.

There is much to be done, and in some areas the need is pressing. Many of the present faculty are carrying too great a burden, and funds are needed for more adequate remunerations. There is a special need for a number of substantially endowed chairs in such important subjects as thermodynamics, machine design, and air conditioning. In some areas laboratory facilities and equipment are urgently in need of modernization, along the lines of the new building program previously outlined in this journal by Dean Hollister. Both industry and government must be brought to a fuller appreciation of their enormous stake in higher education as one of their best possible investments in a highly competitive world.

Above all else, however, the fact remains that the Sibley School is confronted with a splendid, inspiring *opportunity*. Mechanical Engineering is still the most universal and industrially significant branch of the engineering professions. It is the common denominator of all the major industries, underlying the great fields of power generation, transportation, and mass production. One of the newest and most spectacular developments of the age—the atomic bomb and its associated forms of nuclear energy—is as much a triumph of mechanical engineering as of the physical sciences. The gas turbine and the jet engine likewise are tremendously significant legacies of wartime mechanical development.

The future, even the immediate postwar future, holds promise of more and better things to come, some of them as yet hardly dreamed of. By holding fast to all that is best from the past, by making the most of its present heritage, and by anticipating the future in a carefully planned and vigorously implemented program, the Sibley School of Mechanical Engineering can and *will* make its proper contribution to this intensely interesting future.

Alumni News

(*Continued from page* 18)

THOMAS R. COX, M.E. '11, was promoted to lieutenant colonel, AUS recently. He is president of the Broadway Savings Bank, New York City.

CHARLES W. WEBER, M.E. '19, was Display and Exhibit Manager for the Texaco Co., refiners of Texaco gasoline and other petroleum products, from 1927 until 1940. The following six years he worked as Plant Manager for the Empire Ordnance Corp., manufacturers of 75 mm. tank guns and B-17 landing gears. Mr. Weber, who resides in Philadelphia, is now Shop Coordinator of the Research and Development Division of the Franklin Institute.

JAMES HENRY STUBBS, B.C.E. '76, was Cornell's oldest living graduate until he died June 25, 1946, at the age of ninety-four in Haiku, Maui, Hawaii, where he had lived for twenty years following his retirement as a civil engineer.

(*Continued on page* 40)

"He turned the heads of Congressmen"

The words are those of Rufus Choate, spoken in 1840. For in the rotunda of the Capitol at Washington, Clay, Calhoun and Webster were gazing in amazement at busts of themselves, turned by a copying lathe. Standing by was Thomas Blanchard, the inventor, holding a model of his machine. He was seeking a renewal of his patent, and Webster saw that the renewal was granted. To the ordinary surfacer then in use, Blanchard's lathe added the means of turning irregular forms, and since 1819 it had been proving its usefulness on gun-stocks, shoe-lasts and wheel-spokes.

Today all lathes, grinders, drills, boring mills, punches depend for their speed and accuracy upon anti-friction bearings. Many of these bearings are made by SKF . . . for over a long period of years SKF has applied its engineering skill to the development of ball and roller bearing units which meet almost every possible requirement of the machine tool industry.

With such long and diverse experience, an SKF representative is the best man to help you select

THE RIGHT BEARING FOR THE RIGHT PLACE

SKF INDUSTRIES, INC., PHILA., PA.

7004-A

Techni-Briefs

(*Continued from page 20*)

they face a new enemy, known as the General Electric germicidal lamp. It duplicates artificially the germ-killing ultraviolet energy of the outdoors. The lamp's lethal radiation, created by electric current passing through mercury vapor at low pressure, kills organisms ranging from mold spores and yeast cells to pathogenic germs and viruses.

Germicidal lamps have been tested in schoolrooms, hospitals and factories—with convincing results. At one nationally known orphanage in the midwest, physicians reported a 90 percent reduction in the spread of respiratory infection among infants in germicidal-equipped cubicles as compared with those in ordinary cubicles.

During a measles epidemic in the east, the lamps were installed in public schools. The incidence of disease among the children in rooms protected by the germicidal unit was 12.6 percent as compared with 51.8 percent in the rooms without ultraviolet radiation.

In many industries the lamp promotes better sanitation and increased economy. The slicing and wrapping of bread and cake, hand shelling of nuts, the capping of milk bottles, and the sealing of beer and serum bottles—such operations as these create a hygienic hazard which can be largely overcome by the use of the germicidal lamp.

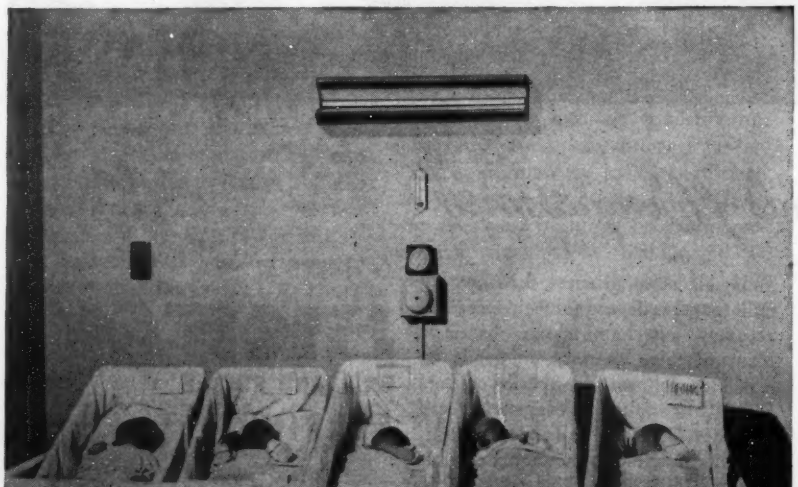
—*Courtesy G.E.*

Germicidal lamps on this ointment packaging line prevent mold from forming in tops of jars.

Installed over the washbasin and adjacent mirror and mounted flush with the ceiling in the bathroom, are a 250-watt Westinghouse infra-red heat lamp and a sunlight lamp. In a nearby cabinet housing the family toothbrushes, a slender, tubular Sterilamp stands guard against possible contamination of the brushes by germs or mold spores.

Two infra-red lamps in an adjoining wall cabinet may be switched on when desired to dry stockings or light lingerie. Two Sterilamps are installed in the kitchen—one mounted over a utensil drawer, the other in a spacious cabinet housing pots and pans.

These new-born babies are protected by ultraviolet radiation, an aseptic measure used in hospitals. —*Courtesy G.E.*



Core Materials

The possibility of manufacturing piano tops, davenports, and overstuffed chairs so light that they can be moved with ease by the average housewife is in the not too distant future.

Comparing the function of low-density core materials with that of the lattice-bars or struts in a girder, they are designed to increase the stiffness of a structure without adding significantly to the weight. More than 100 uses are now envisioned, for low-density core materials.

The DuPont core material CCA, cellular cellulose acetate, is adaptable to assembly-line production, and it will be useful in the housing industry. Wall panels, flooring, cabinets and exterior panels already are being investigated. Panels of the foamy, light material may be composited and cured in 15 seconds or less by high-frequency heating.

The greatest use of core materials at the present time is in aircraft, where more than a score of specific items are already in produc-

(*Continued on page 38*)

This lump of coal has been to finishing school

AND it has graduated with honors as a piece of *coke*.

It's considerably more refined than it used to be. It's a better and more useful citizen, thanks to its coke-oven education.

Now it burns cleaner than ordinary coal. Burns hotter. Burns longer. And it's ready to provide uniform, economical and efficient heat for your home.

Koppers has done a lot to help supply you with this superior fuel. For Koppers has designed and built most of the coke ovens used in America. And Koppers is itself a big producer of quality coke for domestic heating.

That's just a part of the service Koppers offers to you and to industry. Besides domestic coke, Koppers makes couplings, piston rings, airplane propellers. It manufactures materials for paving, roofing, waterproofing. It pressure-treats timber with preservatives to make it more resistant to weather, decay, moisture and fire. And it engages in many other activities.

It is this versatility, the application of Koppers chemical and engineering skills to so many fields, that has built for Koppers its reputation as "the industry that serves all industry". Koppers Company, Inc., Pittsburgh 19, Pennsylvania.

The industry that serves all industry

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We're ready to serve Cornell students, and we've had 51 years of experience in serving them.

◆

THE CORNELL CO-OP

Barness Hall On The Campus

Anti-Icer

(*Continued from page* 30)

gathering of icing information and for testing. In one flying icing wind tunnel, a wing had 200 thermocouples, lining its inner surface, measuring the temperature of its leading edge at all times and places. Measuring instruments of many types were included in this particular model and cameras photographed water droplets and snowflakes as they struck the wing, to better analyze the formation of ice on an airfoil. Veteran "ice cracking" pilots flew researchers into all types of weather to get data of actual conditions of icing, to compare with their other findings. Working models were completed, on the results, to combat the ice through heat. Serious problems arose.

Heat Exchanger

A small heat exchanger was mounted in the exhaust stack of the engine. Exhaust gases at 1400° F. passed through a bank of closely spaced tubes while subzero slip stream air, swept in by a ram air scoop, rushed into the tubes of the heat exchanger. After passing through the exchanger the air was at 300°-350° F. It was driven into the wings and to the tail at that temperature, which kept the aluminum alloy leading edges at 60° F. and warmed the entire airfoil to a lesser degree. When dumped over the control surfaces, at the end of its circulation, it still had a temperature of 80° F.

Problems and Solution

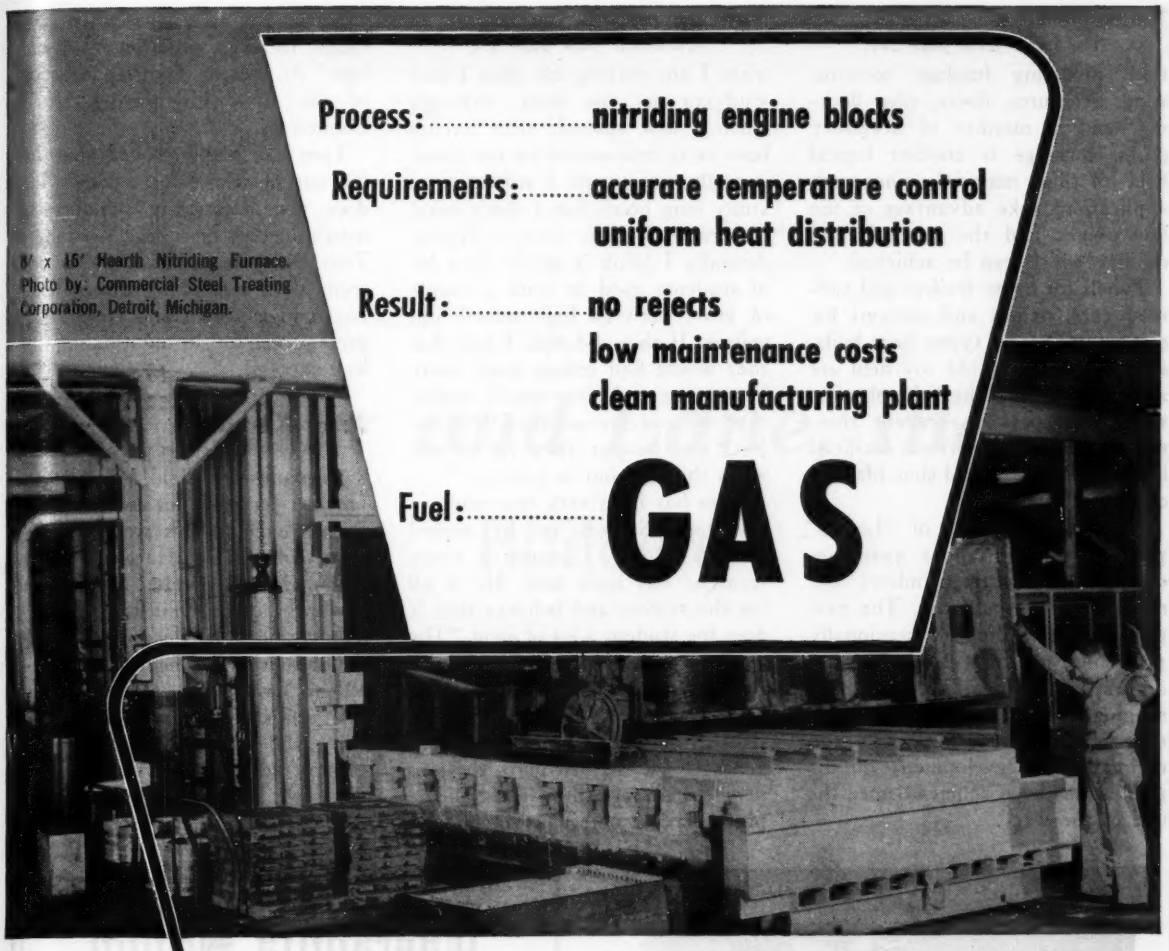
The models could not withstand the overheating, corrosive, exhaust gases on one side and the subzero temperatures on the other side. Leaks and failures would occur before 100 hours of testing were completed. The design of the ram air scoop for the heat exchanger, of the pump for driving the heated air to the tail empennage, and the provision of a control gate added to the overall problems.

By using a nickel-chromium heat resisting alloy, *Inconel**, in the manufacture of the heat exchanger, the problems of overheating, corrosion, and shock were solved. Straight engineering on the design of the remaining obstacles completed the system. Test flights in northern regions functioned perfectly. At full capacity, the system was found to produce an amount of heat equal to that necessary for twenty five-room bungalows in midwinter.

The Army Air Forces installed the hot air anti-icer on a few B-17s and B-24s. Consolidated claimed its Catalina as the first off the production line with the new system incorporated in it. They planned on equipping their PB4Y2, PB4Y, and P4Y-1 with it, too. Meanwhile, the Fairchild Packet was claimed to be the first cargo plane to go into production with the heated wing.

With the development of the hot air anti-icer, aviation is drawing swiftly toward the goal of the banishment of fear and of air disasters due to ice, that has troubled it since man challenged that element in the sky.

**Product of the International Nickel Co., Inc.*



' x 15' Hearth Nitriding Furnace. Photo by: Commercial Steel Treating Corporation, Detroit, Michigan.

Capacity and product specifications for the GAS-fired furnace include:

- **Temperature.....975 degrees F.**
- **Allowable Variation.....+5 degrees F.**
- **Process Time.....96 hours**
- **Case Depth.....0.025 inches**
- **Atmosphere Supply.....Ammonia**
- **Production Rate.....200 Tons per Month**

Commercial Steel Treating Corporation demands accurate temperature control and uniform heat throughout the chamber of its heavy-duty nitriding furnace. GAS fulfills these requirements; five years of successful operation supply the proof.

GAS, dependable fuel for industrial processing operations, meets the most exacting control and heating requirements. Low maintenance costs and cleanliness characterize GAS-fired installations.

Vast new fields for physical and chemical research have been opened by demands in the metal working industry for more extensive use of controlled atmospheres for changing internal and surface characteristics of metals. GAS has become firmly established as the ideal fuel for controlled atmosphere processing.

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Techni-Briefs

(*Continued from page* 34)

tion, including fuselage sections, wing structures, doors, ribs, flooring, and a number of accessory parts. Luggage is another logical field for these materials, since such applications take advantage of the low weight and the strength and rigidity which can be achieved.

Panels for house trailers and railroad cars, panels and sections for refrigerators of all types, boat hulls, and many uses in the toy field are also predicted for the light plastics, which also possess excellent thermal insulating properties. Artificial limbs, card tables, and shoe lifts are other possible uses.

Transparent sheets of "Lucite" were used in enormous quantities during the war for windows and noses of military planes. The new process makes them exceptionally promising for a wide variety of decorative and utility purposes, ranging from washroom windows to edge-lighted panels for hotels and night clubs. Development of the process has been achieved since the end of the war.

Tom Berry

(*Continued from page* 17)

what I am striving for, thus I find studying not too hard; although when I first started, after having been away from school for ten years, it really was tough. I still have to study long hours but I don't mind it because I really want a degree. Actually I think it would do a lot of students good to work a couple of years between high school and college. If they did this, I feel that they would find college much more interesting and they would realize that some of the so-called dry subjects can be put to a lot of use when they get out in practice."

Tom has been very interested in the Honor System, and has served on the Honor Committee every term he has been here. He is all for the system and believes that it does the student a lot of good. "The system puts the student on his own, and makes him realize that when he gets out to work in industry he only has his own intelligence to use. Also it gives the student a sense of ethics to use in the profession, something which every engineer has to practice but isn't taught to a very great extent in college." At present Tom is Chairman of the Civil Engineering Honor Committee.

Tom has really proved that being out of school for a long while does not necessarily handicap a man's success in college. In fact if Tom Berry is the example it will seem that a working interval between high school and college is a prerequisite for an outstanding college success.

Jerry Kennard

(*Continued from page* 16)

Airplanes still hold a fascination for him. Jerry got his civilian pilot's license back and is working on a model of a B-24. He enjoys making intricate, precise models and remarks how easy it is to build a ship inside a bottle.

Graduation is scheduled for June. When Jerry says "Good-bye," all his friends, though sorry to see him leave, will wish the very best of luck to a veteran, who served his country well, and an all-around Cornellian.

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College News

(Continued from page 19)

Winners of the 1946 McMullen Scholarships are:

Chemical Engineering:

Joseph W. Calby, Jr., Robert J. Entenman, David G. Bowen, Jr., Donald P. Victorin, Robert M. Sims, Charles L. Sweeney, Charles H. Campbell, Paul E. England, William C. Brasie, James K. Preston, Dean R. Dickinson, Richard C. Gnaedinger, Stanford H. Taylor, John H. Barnard, John C. Hedberg, Eugene L. Stanisauskis.

Civil Engineering:

Kirl E. Birrell, John B. Johnson, Robert D. Lamke.

Electrical Engineering:

John H. Gay, Richard P. Taylor, David H. Blauvelt, Victor K. Pare, John E. Gerling, Graham I. Smith.

Mechanical Engineering:

Irving A. Quimby, II, Donald R. Worn, John E. Rogers, Walter S. Crone, Alton R. Pope, William W. Farquhar, Paul S. Jones, Robert L. Cadwell, Jonathan S. Ayers.

National Scholarship winners are:

William E. Bunyan, M.E.; Richard N. Houston, E.E.; Russell C. Voorhis, C.E.; Jonathan K. Woods, M.E.; Lawrence W. Woodworth, C.E.; Robert C. West Jr., Ch.E.; F. Allen Longley, Ch.E.

Alumni News

(Continued from page 32)

Richard Wallace Pitman, M.E. '28, headed the Pitman Engineering Co. in New York for nine years following his graduation from Cornell. In 1932 he developed the automatic gearshift for Nash. From 1937 to 1939, Mr. Pitman developed and sold a large variety of inventions, some of which involved automatic phonograph record changers, attachments for typewriters and computing machines, and a word counter for Western Union. His work as Research Engineer for the Underwood Typewriter Co. in Hartford, Conn. inventing electronic and mechanical devices pertaining to adding machines and typewriters, resulted in basic patents on the application of electronics to adding and calculating machines. In April, 1942, Mr. Pitman began special instrumentation and computer work for the Navy Department's Bureau of Ordnance and the Army Air Forces. Because of his excellent achievements in this project, Vice-Admiral Hussey presented him with an individual certificate in "appreciation of exceptional service to Naval Ordnance Development." At the present time, Mr. Pitman is working on a project which the Franklin Institute Laboratories for Research and Development are performing under contract with the Navy.

William H. Boehm, M.M.E. '93, retired as vice-president of Fidelity and Casualty Co. in charge of steam boiler and machinery insurance since 1938.

D. T. Braymer, M.E. '33, formerly western editor of the *Electrical World*, Chicago, has been transferred to New York as managing editor.

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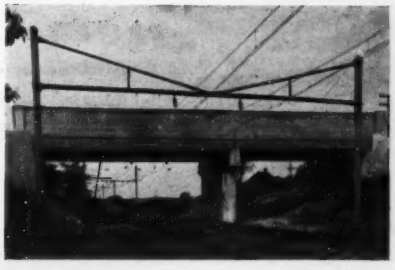
Bridge Construction

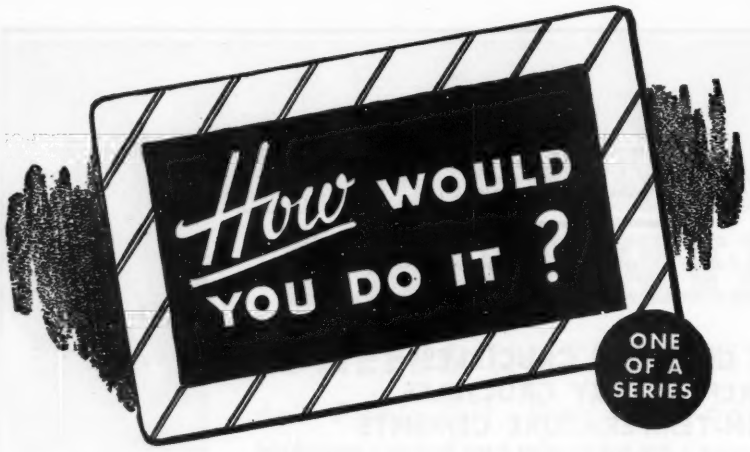


Project: Series of 3 highway bridges over Pennsylvania and Reading Rail Roads, Lancaster, Pa. Completed 1946. (Shown) Bridge over Columbia branch of Pennsylvania R.R.

Cayuga Construction Corp.

30 Vesey Street, New York 7, N. Y.

Daniel M. Lazar, '29, *President*
L. Sanford Reis, '29, *Treasurer*



PROBLEM—You're designing a taxi-cab meter. You have worked out the mechanism that clocks waiting time and mileage and totals the charges. Your problem now is to provide a drive for the meter from some operating part of the cab—bearing in mind that the meter must be located where the driver can read it and work the flag. How would you do it?

THE SIMPLE ANSWER

Use an S.S.White power drive flexible shaft. Connect one end to a take-off on the transmission and the other to the meter. It's as simple as that—a single mechanical element that is easy to install and will operate dependably regardless of vibration and tough usage. That's the way a leading taximeter manufacturer does it as shown below.

★ ★ ★

This is just one of hundreds of power drive and remote control problems to which S.S.White flexible shafts are the simple answer. That's why every engineer should be familiar with the range and scope of these "Metal Muscles" for mechanical bodies.

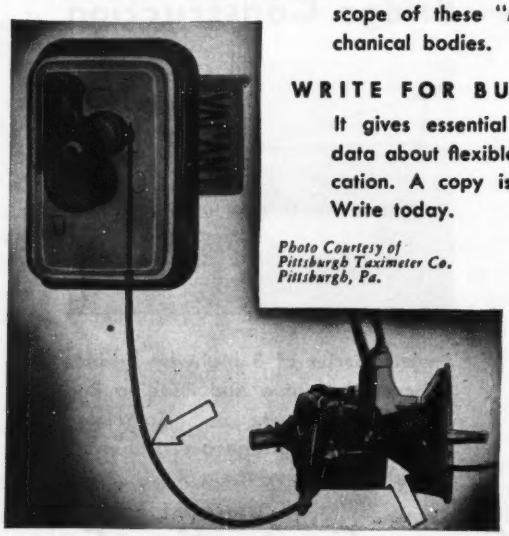


Photo Courtesy of Pittsburgh Taximeter Co. Pittsburgh, Pa.

WRITE FOR BULLETIN 4501

It gives essential facts and engineering data about flexible shafts and their application. A copy is yours for the asking. Write today.

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Metallurgy of Copper

(Continued from page 26)

of the soda fluxes completes the removal of the impurities. This process takes two to three days at the end of which time the silver is cast into anodes to be used to electrolytically remove the silver from the gold using an electrolyte of silver nitrate.

Electrolytic Separation

The tank is a rectangular earthenware container about three feet long, two feet wide, and one foot deep. The cathode is a graphite plate covering the bottom of the tank while the anodes are laid horizontally across the top and contained in a canvas bag. The silver deposits out on the cathode and the loose crystals are scooped from the bottom of the tank every few hours, washed, melted and cast into bars of 99.95 percent purity. The gold is retained in the canvas bag as an impure slime which can be purified by boiling in sulfuric acid, washing with nitric acid, and then being melted and cast into bars. Small but important amounts of platinum and palladium are recovered from the gold purification. This is all done in the copper refineries to help pay for the cost of refining.

Importance of Copper

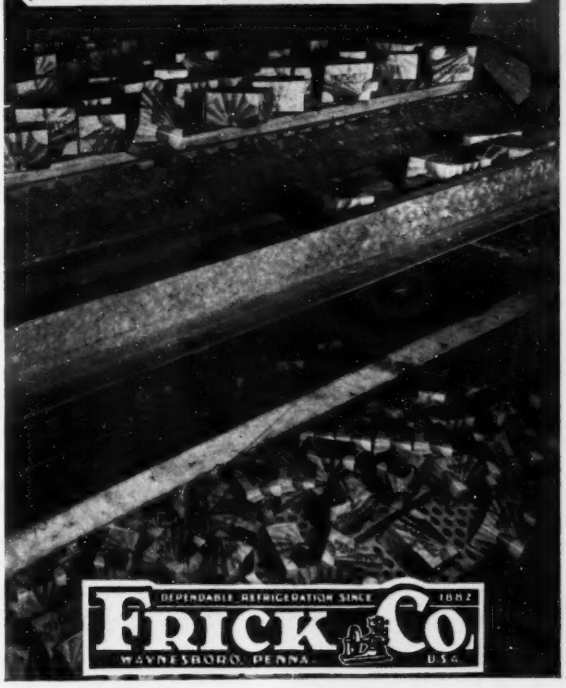
Copper has many uses. In fact steel, aluminum, and copper are the most useful metals produced. Copper is valued as a structural material because of its ductility and resistance to corrosion rather than because of its strength. It is used to produce many types of alloys the most common of which are bronze, composed of copper and tin, and brass, composed of copper and zinc. Copper is extensively used for pipes, tubes, stills, condensers, evaporators, autoclaves, and pumps. However the most important use of copper is in the electrical industry. Most of the copper produced in the United States is used to produce electrical equipment. Thus it is seen how important smelting and refining of copper has been in this modern industrial world.

Norton Printing Co.

317 E. State St.

ICE CREAM IS FROZEN AT 50° BELOW ZERO in this tunnel at the Hershey Creamery Company, Harrisburg, Penna. Double conveyors, 120 feet long, handle the packages on two levels, automatically. Low-temperature air, blown from cooling coils overhead, freezes the product in less than an hour: rata, 180 pints per minute!

Twice enlarged and now in its eleventh year of operation, this Frick-Freezer is still supreme in its field. Consult the nearest Frick Engineer about that quick-freezer, to handle ANY product, needed by your community or business.



His lamp could burn for 30 years

on the extra power produced when 2 boilers replaced 6

IN PLACE OF SIX BOILERS, a big eastern power company is now installing *two*. These two modern boilers generate nearly twice as much steam as the original six . . . help produce far more electric power, too.

Enough more *each hour* to play 625,000 radios . . . or to burn a 100-watt bulb in your study lamp *continuously* for 30 years!

This B&W boiler installation typifies the progress made during recent years in raising steam generating efficiency—progress in which B&W has consistently lead the way. B&W, old in experience, has pioneered important advances in many other fields too—yet B&W is still young enough to have new ideas for all industries on present problems and future plans.

Through this progressive policy of continuous research and development, B&W offers excellent career opportunities to technical graduates—careers in diversified fields of manufacturing, sales, engineering, research and in many other vocations. Send for the booklet "Your Career". It tells the story of The Babcock & Wilcox Company in terms of your future.

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STRESS and STRAIN...

The horse and mule live thirty years
And nothing know of wine and beers.
The goat and sheep at twenty die
And never taste of Scotch and Rye.
And cow drinks water by the ton
And at eighteen is mostly done.
The dog at fifteen cashes in
Without the aid of rum or gin.
The cat in milk and water soaks
And then in twelve short years it croaks.
The modest, sober, bone-dry hen,
Lays eggs for noggs, then dies at ten.
All animals are strictly dry,
They sinless live, and swiftly die.
But sinful, gin-full, rum soaked men
Survive for three score years and ten;
And some of us, the mighty few,
Stay pickled 'Til we're ninety-two.

"Your wife needs a change," said the doctor. "Salt air will cure her."

The next time the physician called he found the Scotchman sitting by her bedside, fanning his wife with a herring.

* * *

Rastus (throwing down four aces): "There, guess I win this ole pot, all right."

Sambo (angrily): "You play this game honest, boy; play it honest! I knows what cards I dealt you!"

* * *

Chemist's Note

Always measure out cyanide solutions in graduates, not pipettes. If you use pipettes there won't be any graduate.

* * *

It is said: "The noblest kind of dog is the hot dog—it actually feeds the hand that bites it."

"They're looking for a place where it will fit."

Roommate: "Hey, wake up! There's a guy in here stealing your clothes."

Awakened: "What do you want me to get up for? You two just fight it out between yourselves."

* * *

"I'd like to be cremated, but I'm not sure my wife would like it."

"Why not?"

"She's always complaining about my leaving my ashes around."

* * *

Smith: "Robinson, the banker, has stolen $100,000 of the funds and ran away with the hotel keeper's wife."

Smythe: "Heavens! Who will teach his Sunday School class?

* * *

"Did you know that I had taken up story writing as a career?"

"No, sold anything yet?"

"Yes, my watch, my saxophone, and my overcoat."

* * *

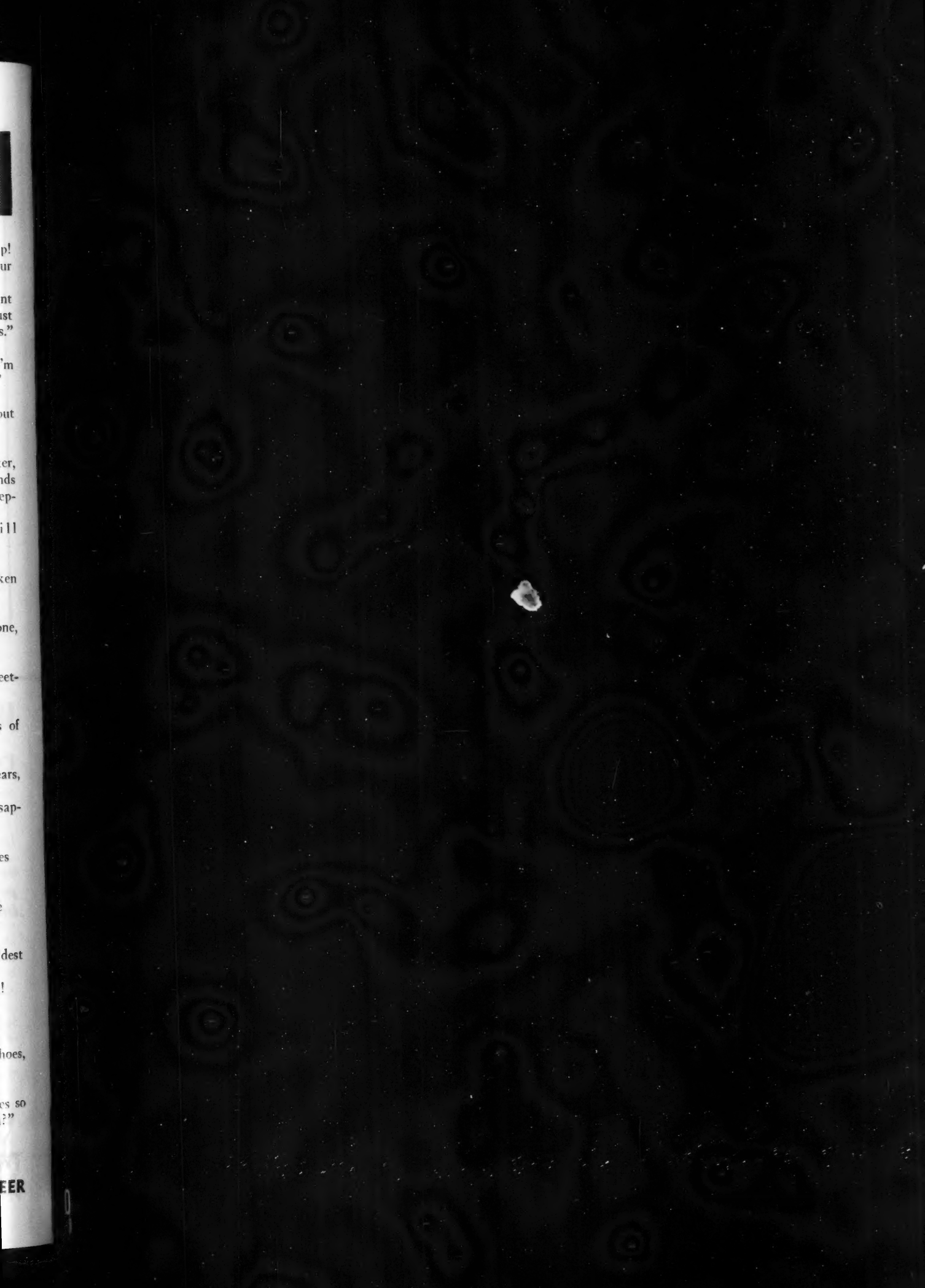
There are three words, the sweetest words
In all the human speech—
More sweet than all the songs of birds,
Or pages poets preach.
This life may be a vale of tears,
A sad and dreary thing—
Three words and trouble disappears
And birds begin to sing.
Three words, and all the roses bloom,
The sun begins to shine;
Three words will dissipate the gloom
And water turn to wine.
Three words will cheer the saddest days—
"I love you?" Wrong by heck!
It is another sweeter phrase,
"Enclosed—find—check."

* * *

Small boy: "Shine your shoes, mister?"

Grouch: "No."

Small boy: "Shine your shoes so you can see your face in them?"

Grouch: "No."

Small boy: "Coward."